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ENGINEERING AND MINING JOURNAL-PRESS

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New Cornelia Concentrating Mill at Ajo, Arizona

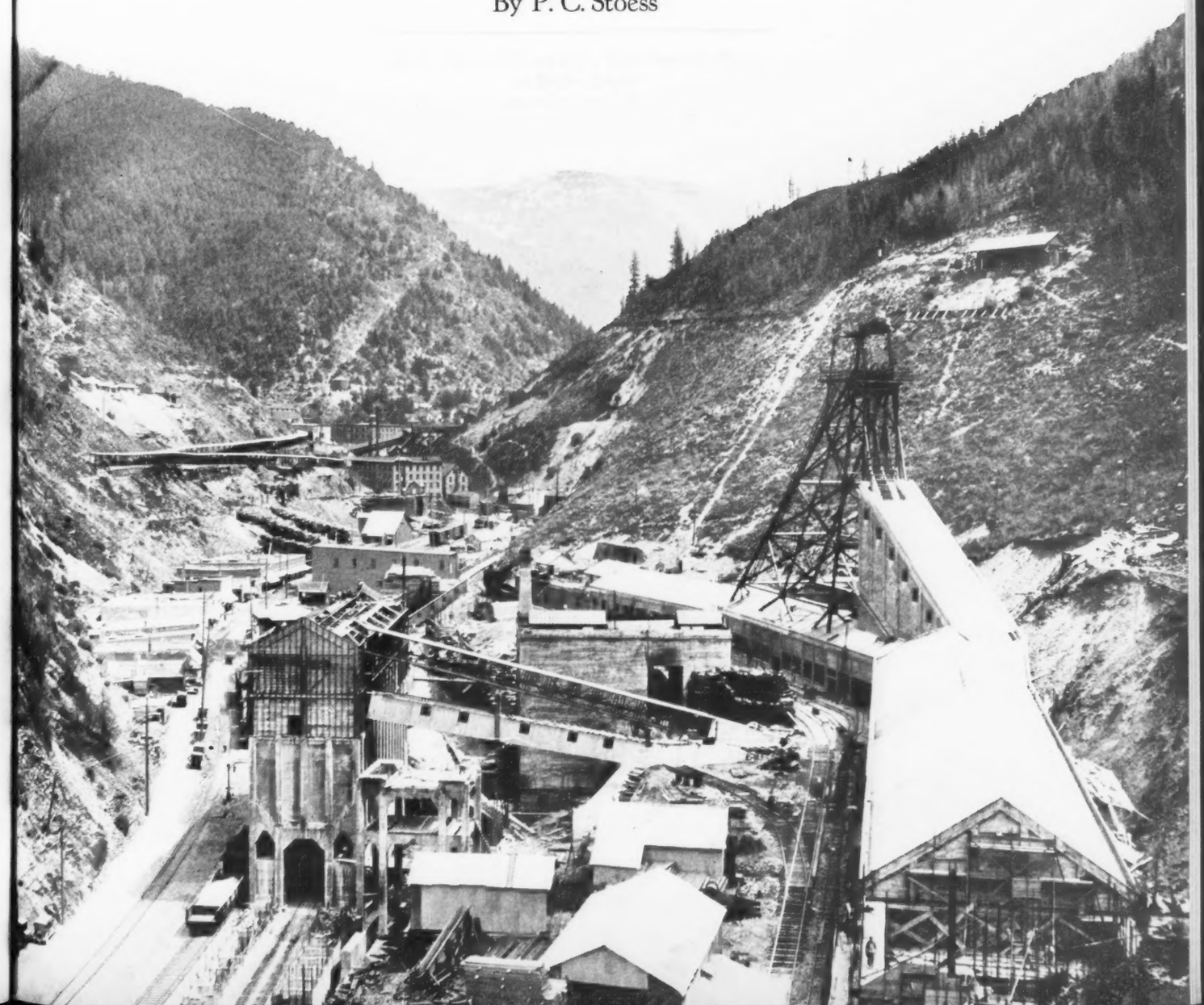
By H. Kenyon Burch

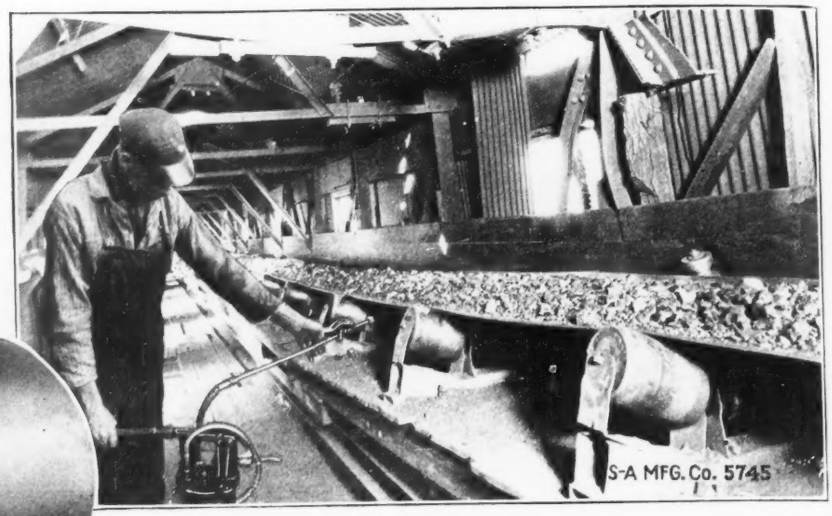
Functions of the Silver Producers' Association

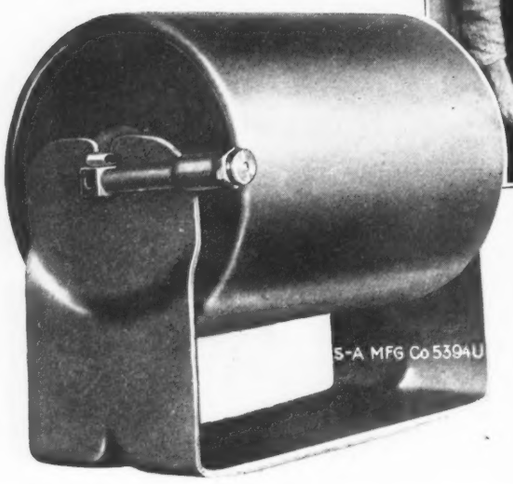
An interview with Francis H. Brownell

Arsenic Deposits Near Seattle, Washington

By P. C. Stoess







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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

Volume 118 New York, November 22, 1924 *Number* 21

The College Graduate in Business

WHAT SORT OF MEN go into the best executive positions? Is college training an indispensable asset for those who would occupy such places of trust and influence? A college president recently estimated that a college degree is worth $74,000 to the average graduate during his lifetime. Is that a fair estimate of the case?

The National Industrial Conference Board is conducting a survey to find out: "What kind of training does industry expect from men needed for executive, administration, and technical positions?" Mark the word technical, for this comes home to our readers. The board has selected for specific studies, ten or twelve major branches of American industry, and is studying the situation in each industry separately. Two industries have already been surveyed from this standpoint: the rubber industry and the pulp and paper industry. In the former seventy-five companies co-operated in the investigation; they represent 113 plants and more than 100,000 employees, and constitute 63 per cent of the entire rubber industry. Of the total number of employees, 7 per cent occupy important positions; and of this 7 per cent, only 23 per cent are classified as college graduates.

In the paper and pulp industry, the results of the investigation yielded figures astonishingly similar to those for the rubber industry. From a poll of 150 companies employing more than 35,000 persons, it was found, again, that 7 per cent had executive or other important positions; and again, that of these 7 per cent, 22 per cent were college graduates, 13 per cent being graduates of colleges recognized as giving degrees in technical courses.

Why are not the college graduates better represented? The current opinion is that the college graduate has the advantage in competition over the man who has not had a college training. Nevertheless, the patent fact that so many men rise to the top without such training has led thoughtful observers to the conclusion that the college man had possibly a competitor with almost equal chances in the man who had never seen a college, but who had had the benefit of the course in the University of Hard Knocks. But here are figures which even raise the whole question whether college training is an aid in business, or not. There are plenty of college men for candidates. The number turned out of the college mill annually is enormously greater than ever before. But their college diploma is not an open sesame. Nowadays it is not even considered as an asset in the business world which most graduates enter: it is altogether a question of "making good." The report of the board states:

"One of the problems existing in adapting college graduates to responsible positions in industry is the difficulty of obtaining practical experience in line with theoretical instructions."

The Flotation Situation

THE EXPIRATION of the famous flotation patent No. 835,120, issued to Sulman, Picard, and Ballot, and covering the use of less than 1 per cent of oil in connection with violent agitation, has apparently not resulted in Minerals Separation losing any of its licensees. Practically all of the important mining companies with the exception of Magma Copper, and most of the smaller operators, continue to pay royalty for the use of the process. Minerals Separation has, however, consented to a 50 per cent reduction in the amount of the royalty, provided its licensees will continue their payments until the expiration of the other important patent, No. 962,678, covering the use of soluble frothing agents, which will be on June 29, 1927. What will happen after that is problematical. It is likely that the royalty fee will again be reduced to such a figure that it will pay operators to continue as licensees so that they may get the benefit of various minor improvements controlled by the patent exploiting company. Some of these are probably of considerable utility. A recent introduction, for which the Minerals Separation research engineers seem to be responsible, is the use of potassium and sodium xanthates as flotation reagents. These salts are now being used by several of the larger companies, with a marked improvement in recoveries; they have proved of value in selective work and in some instances in the flotation of oxidized mineral. The use of xanthate is one of the most important advances made in the technology of the flotation process in recent months.

Unfortunately, flotation litigation is still with us, though in lessened amount. The Magma suit is still before the court, but the judge's decision is overdue; it may come at any time. The Wolf suit has been postponed again, this time until January, we understand. And there is some litigation pending with regard to the use of certain reagents.

The Gold Miners' Predicament

AT THE AMERICAN MINING CONGRESS convention certain gold producers voiced their contention that the gold-mining industry needs substantial aid. It is admitted that taxes, labor, and commodity prices have increased the cost of producing gold over what it was ten years ago. In some instances, perhaps, gold mining is conducted at a loss and in others the mines are using up ore reserves with little to show for their efforts outside of a stack of paid bills. As A. B. Foote remarked at the convention, the troubles of the gold miners are economic and therefore difficult of solution. Not so long ago the farmers were in a similar predicament, but with the rise in the price of grain a rosier viewpoint supervened.

The fixed price of gold rankles some of the gold producers, who see no reason why the manufacturing jeweler should not pay more for his gold than $20.67

per oz. Several gold producers are still toying with the idea crystallized in the McFadden bill. The gold excise tax idea was a good one under the conditions existing when it was promulgated as a war measure, but it is now only a legislative curiosity. The idea that it can be given a new dress and a cockade hat and again introduced in the ballroom of Congress is fatuous. Something can be done collectively by asking Congress to cut down governmental expenditures and thus be able to reduce federal taxes. The reduction of local taxes is an individual problem too diffuse for collective handling.

Legislation as a means for improving conditions in a basic industry is a resort of doubtful expediency when compared with self-help. Individually, there exists a problem at each gold mine for the manager and his assistants. A drastic examination of existing methods and effective steps for their improvement are as essential in gold mining as in copper mining. It is in this direction that progress can be made. To await the time when economic conditions readjust themselves involves a degree of inaction that is not properly to be considered. To shut down a property admits defeat.

Interest in gold mining in certain districts is at a low ebb, no doubt; but this is the resultant of numerous factors, most of them beyond the control of the gold miners. However, the interest factor will swing again in the direction of the miner as it has in the past. And, it must not be forgotten that many gold mines are really prosperous. Even the old Homestake manages to make almost as much money as it did before the war, and there are numerous newer mines, led by the Hollinger, which pays to its stockholders a quarter of a million dollars every month.

From Oil Lands to Mines

ACCORDING to the Associated Advertising Clubs of the World, whose president has asked us to warn mine owners, a large portion of the horde of fake oil-stock promoters, who in recent years have defrauded the public of hundreds of millions of dollars, is turning its attention to mining. The movement has not yet gained great momentum; it is hoped to forestall it in a measure. But that the dishonest promoters are switching their efforts is indicated by an increase of more than 50 per cent in the inquiries regarding stocks in alleged metal-mining enterprises that have come to the Advertising Clubs in the last three months. Moreover, the National Vigilance Committee has been able to identify many of the men now engaged in selling mining shares as being the same individuals that they investigated in connection with oil frauds.

Partly as the consequence of the relentless fire of publicity, and partly because of the depression in the oil industry, the professional stock-jobber has found it advisable to change his field, and the increasing prosperity of silver and lead and zinc mining and the prospect of better times for gold and copper producers has directed his attention to metal mining—if the diagnosis of the Advertising Clubs is correct. Many of the men engaged in fraudulent promotions and stock selling are clever and versatile. They are able not only to sell worthless stock to the public, but they can swindle the owner of a legitimate mine prospect, if he is not exceedingly careful.

The Associated Advertising Clubs and similar agencies are campaigning continually to educate the public, and in that way to drive the crooked promoter out of business. We urge the owners of small mines and prospects who are seeking financial aid to be more careful than ever in their dealing with shrewd stock salesmen who offer their services to raise funds. The more plausible their offer seems, the smoother they are, and the more likely they are to defraud you as well as the sucker who buys the shares.

Gold and Mercury

TRUE TO OUR DETERMINATION to keep abreast of the latest developments in alchemy, we note that a professor of physics, Professor H. H. Sheldon, of New York University, has begun a series of experiments under the direction of the *Scientific American*, with the object of converting mercury into gold by a different process than that described as having been used by Dr. Adolph Miethe in Berlin and Dr. H. Nagaoka in Tokio. The problem as stated is plain: the atom of gold possesses seventy-nine electrons; that of mercury eighty electrons. Knock off one electron from the mercury and you have gold. What could be simpler? Mr. Free, editor of the *Scientific American*, in an interview reported in the daily press, stated that the object was not only to obtain gold in this way, but to find out how much it would cost to do it, and whether and how much the results will tend to cheapen gold now, or at any calculable time in the future. Reports concerning the investigations, he added, will be published from time to time, "unless as a matter of public policy it seems wise to delay their publication."

Thus frankly starts out another hunt for a club wherewith to dislodge effectively and easily the humble and inoffensive redundant mercuric electron. The *Scientific American* wins the calculated publicity, whether or not gold is won. As to the latter, gold miners and holders of gold-mining stock will wonder whether they had better not cash in while gold is still dear. While the American Mining Congress is hoping to boost gold to $30 an ounce, the *Scientific American* is traitorously trying to cut the price to $5. However, the panic should not begin at once. The old recipe for rabbit stew still holds good: "First, catch your rabbit." First swat the electron. As to the publication of results, it is to be assumed that if experiments succeed in producing gold cheaply, Professor Sheldon and Mr. Free would do the indicated thing—manufacture a generous supply of the yellow metal and convert it into real estate at the current value for gold; then gradually break the news which will break the gold miners. In the meantime the gold miners will hang the familiar consoling motto on the walls of their assay laboratories: "I am old and have had many troubles, most of which never happened."

Another Angle of the Copper Tariff Problem

SUPPOSE, for the sake of argument, that copper production in this country should suddenly become 10 per cent less than the current deliveries to domestic users: the apparent, but not the true, domestic consumption. Suppose that simultaneously a tariff were placed on imports and that the price of copper in the United States immediately became 4c. higher than the price elsewhere in the world, because of the necessity of importing 10 per cent of domestic requirements. In a rough way these are the conditions that advocates of a tariff conceive.

Now, a considerable proportion of the copper included in this so-called domestic consumption goes into manufactured or semi-manufactured products of copper and brass that are exported to foreign countries. These products must compete with similar manufactures of other countries. By virtue of superior organization and more efficient use of machinery and labor, American manufacturers are able to offset the lower wages paid in other countries. But the margin is not great; if it were, Americans would be able to undersell their foreign competitors and would virtually monopolize the business. A condition approximating free competition exists.

But suppose that the American manufacturer were faced with the necessity of paying 4c. per pound more than his foreign competitor for raw copper. His production cost would go up, he would necessarily increase his selling cost, and he might lose a large part of this foreign business. Then he would curtail production, reduce his purchases of copper, and incidentally discharge some of his men. The same series of events would occur in the business of hundreds of other manufacturers using raw copper. To carry the argument to its logical conclusion, the cumulative result would be a large drop in the apparent domestic consumption; the 10 per cent excess over the domestic production of metal would disappear, and soon the domestic and world prices would be the same, and the tariff might just as well never have been written, as far as the owner of the American copper mine is concerned. As to the manufacturer, he might recover his business and his employee might get his job back, but both would have lost something.

This is only one angle of a very complex problem. Other factors would operate, so that the sequence of events would not be so rapid and so smooth as it appears in the writing, but the principle is sound.

As we have said before, we are not opposing a tariff on copper; we are trying to shed light on a big economic problem. We want the Michigan copper producer to feel sure that he can benefit from a tariff if he gets one through Congress.

Farming and Mining Are Businesses

PRESIDENT COOLIDGE, in a recent speech before the association of Land Grant Colleges, dwelt upon the changed situation in the farming industries and pointed out the importance of the study of marketing. He said:

> "The farmer is not only a producer; he is likewise a merchant. It does him no good to get quantity production. In fact, it may do him harm unless he can likewise have a scientific marketing. I feel that too little thought has been given to this most important phase of agriculture. I want to see courses in co-operative marketing and farm economics alongside of soil chemistry and animal husbandry. The agricultural problem of today is not on the side of production, but on the side of distribution. I want to see a good farmer on a good farm raise a good crop and secure a good price."

We quote this because it may be used almost word for word for the miner as well as for the farmer. We have reached the stage when business methods are all-important for the mining industry, just as they are for the farmer. The miner must understand where his product can be sold and in what quantity. He must, moreover, be a salesman, pushing the sale and suggesting the consumption of his asbestos or molybdenum, just as the California fruit grower has done with his raisins. And he must visualize and plan all these things before he ventures into any mining enterprise.

Engineering and Mining Journal-Press has realized as the most important and most neglected part of the mining industry, the understanding of how the product is to be sold—the science of marketing. It has pioneered in this study for nearly five years, publishing article after article in a carefully planned series—each article dealing with the marketing problem of a certain metal or mineral. These are about to be issued in book form, in accordance with the original plan, and may well form a basis for the study of marketing in mining schools. Mining schools must eventually recognize, as we pointed out long ago, that mining is a business, not a profession; or they must go out of business themselves. Mining engineers must recognize the same fundamental fact: cease trying to range themselves with the doctor and lawyer—a false classification; and understand that they are rather to be compared with the graduate of an agricultural college whose business it is to conduct a basic industry by the aid of up-to-date technology, but, above all, of sound business methods and common sense.

Antimonial Lead Comes Into Its Own

A FEW YEARS AGO antimonial lead was a drug on the market. Large stocks, the result of intensive shrapnel manufacture, were available, and they could have been bought at unusually heavy concessions below the price of common lead. Even a few months ago antimonial lead sold for prices about 1½c. below the common lead market, but today conditions have changed so abruptly and strikingly that these discounts have almost disappeared. Last week one of the largest consumers of antimonial lead was fortunate in buying a fair-sized lot at ¼c. per pound below the spot lead price. The demand for antimonial lead is so good, however, and promises to continue, that the margin between the price of that product and purer grades of lead is expected to disappear before long. Trade circles predict that both metals will sell for the same price early next year, if not sooner. In view of the scarcity of antimony and the high prices for which it is selling it is logical to conclude that the extraordinary condition is in prospect of antimonial lead selling for more than common grades of lead.

The strength of the antimonial lead market is principally owing to the violent advances that have occurred in the price of antimony. Last week antimony jumped close to 3c. per pound in value in the space of seven days—from 12 to 15c. per pound. Owing to the fact that antimony is worth about 75 per cent more than lead, the assumption is pardonable that antimonial lead should be selling for more than common lead. The reason for the customary discounts is to be found in the other impurities, chiefly copper, tin, iron, and arsenic, which most manufacturers find undesirable. The presence of these elements really penalizes antimonial lead and explains why producers are content to receive less than the value of the material calculated from its analysis. A further rise in the price of antimony may be more than sufficient to neutralize the effect of the presence of these impurities. At the moment there is nothing to indicate that the upward movement of antimony is over. The same forces which raised it to its present value—chaotic conditions in China—are still at work.

Functions of the Silver Producers' Association

An Interview with Francis H. Brownell, First Vice-President of the American Smelting & Refining Co.

DURING 1923, the plants of the American Smelting & Refining Co. produced about 93,000,000 oz. of new silver. That was more than one-third of the world's production. From its own mines and those of its subsidiaries, it produced almost 20,000,000 oz. As first vice-president of the company that is the world's largest miner as well as seller of silver, Francis H. Brownell necessarily must study carefully every phase of the silver situation; and the result of his study is that he probably knows as much as anyone about the details of a rather intricate subject. We allude rather to the economic than to the technical phases of the question. Incidentally, the scene of Mr. Brownell's business career before he came east was the State of Washington. He was associated with the Federal Mining & Smelting Co., of Mullan, Idaho, first as its lawyer, then as its president. He understands and sympathizes with the Western psychology, and his views on the silver question should, and do, carry great weight with the Western mine owner. It is for these reasons that we have asked him to discuss the most fruitful field for the activities of the American Silver Producers' Association, that was formally organized in Salt Lake last August.

Francis H. Brownell

An important feature of the original conception of an organization of silver producers was the idea that it might function as an export association, under the Webb-Pomerene Act. Agitation started early in 1923, and at the Reno meeting of producers, in September last year, a committee was appointed to investigate thoroughly the legal as well as the economic aspects of such an association and to make a report. This report recommended deferring the formal organization of an export association, but advised further study of the problem. In this connection, Mr. Brownell says:

"Like any similar organization we may look forward to a period of evolution and development. As I understand the Webb-Pomerene Act, an export association can almost instantly be formed. All that is necessary is to file with the Federal Trade Commission articles to the effect that an association is organized to function under the Webb-Pomerene Act. That would be the only legal step necessary. The details of the method of conducting a co-operative export business would remain to be developed. The problems are many and great; they involve the revolutionizing of the present process of marketing both ore or concentrate and silver bullion. Just what limitation would be imposed under the recent rulings of the Trade Commission should be definitely determined by competent legal counsel. At any rate, we are in a position to form an export association whenever it seems advisable, but this should be done only after careful study. Membership in the present association in no way imparts any obligation on any member to join an export association, should one be formed, the existing organization being limited strictly to a further study of the subject."

The Federal Government has agreed to appropriate $15,000, providing an equal sum be raised by the industry, to finance research to determine the composition of alloys of silver that will not tarnish. This money, Mr. Brownell thinks, should be raised at once, as should a fund for popularizing the use of silver for utilitarian as well as ornamental purposes, particularly in the home. He says:

"When I was a young man (Mr. Brownell knew that what he said might be used against him, so this implied confession was made advisedly), whenever any one was married the wedding presents were largely of silver. In every home where they could be afforded were vases, platters, various kinds of tableware, and objects of ornament and art made of silver. Today, comparatively little of this is seen. To restore silver to its former popularity, two things will help greatly: first, the finding of an alloy that will prevent the tarnishing without destroying the beauty of silver; and second, the education of the public, particularly the ladies, as to the merits of silver as a material for ornaments. If silver could be made fashionable again, the consumption would increase tremendously. Silversmiths have been sending speakers to women's clubs to discuss the use of silver from the standpoint of art and to interest them in decorative objects of both modern and antique design. Many similar plans for legitimate and dignified advertising suggest themselves. They offer a most fruitful field for the Silver Producers' Association."

But the paramount opportunity at this immediate time, in Mr. Brownell's opinion, is the promotion of sales of silver to the countries of Europe struggling to recover from the economic effects of the war. The Oriental countries are of course important buyers of silver, but their requirements will rise or fall from causes entirely outside the influence of the producers in America. On the other hand, co-operative effort on the part of pro-

ducers may have an important bearing on the early restoration in Europe of the coinage of silver on a greater scale. Mr. Brownell, showing the underlying reasons why silver is necessary as the metal for subsidiary coinage abroad, says:

"Any man who traveled through Europe before the war and saw the life of the peasant in France, Germany, Holland, Belgium, Italy and Spain—and I am told even more markedly in Russia—realized that among the people who never go into banks, silver was the great metal of currency; and the subsidiary coinage of silver in use in Europe covered possibly as large a proportion of the total volume of business—because it liquidated the transactions between so many millions of the population—as did gold, which covered the international balances, and those of Big Business, so called. Then came the war. It had not been in progress but a year or so when Gresham's well-known economic law began to be manifested in Europe, and silver and gold alike disappeared from circulation; paper alone was passed among the people. This paper steadily depreciated in value until in a large part of Europe, as we know so well, it passed into worthlessness.

"We are about reaching the state in international affairs when the nations are bound to get together and do business. But, first, currencies must be stabilized; and the opinion I wish to advance with emphasis is that, no matter what economists, and statesmen, and bankers may conclude as to the most ideal currency, theoretically, the psychology of the great mass of the common people of all European nations, who have seen their former currency become depreciated, is such that confidence cannot be re-established unless the common people have for their business a money in which there is intrinsic value, irrespective of the fate of their nation. How can we expect the illiterate peasant of Russia, as he recalls the money of the magnificent empire of the Czars; the somewhat more enlightened peasant of Austria, as he reflects on his bitter experience with the money of the once glorious empire of Francis Joseph, with its background of a thousand years of eminence; or the peasant of Germany, most enlightened of them all, as he compares the German money of today with that of the imperial time of Bismarck—how, I repeat, can we expect any one or all who have gone through the bitter agony caused by the depression of a formerly respected currency to have confidence for generations to come in any money or system of money that does not provide a coin having intrinsic value of itself—a coin which can be hidden away in the old stocking in accordance with immemorial habit, in perfect confidence it is a real saving no matter what wars may arise or governments fall. That means silver, as well as gold. Gold is not plentiful enough and cannot be divided into small enough units fully to answer the purpose. There must be a large volume of silver also."

Mr. Brownell cites experience in Mexico, where Carranza found that the Mexican peon demanded silver coins and obtained them. He relates the events in Austria, where even after the League of Nations had assumed entire control of fiscal affairs, first paper currency and then coins of alloys containing some copper or nickel were put into circulation, but where it soon became necessary, in spite of the guarantees of the League, to supply silver coins, the only thing in which the people believed.

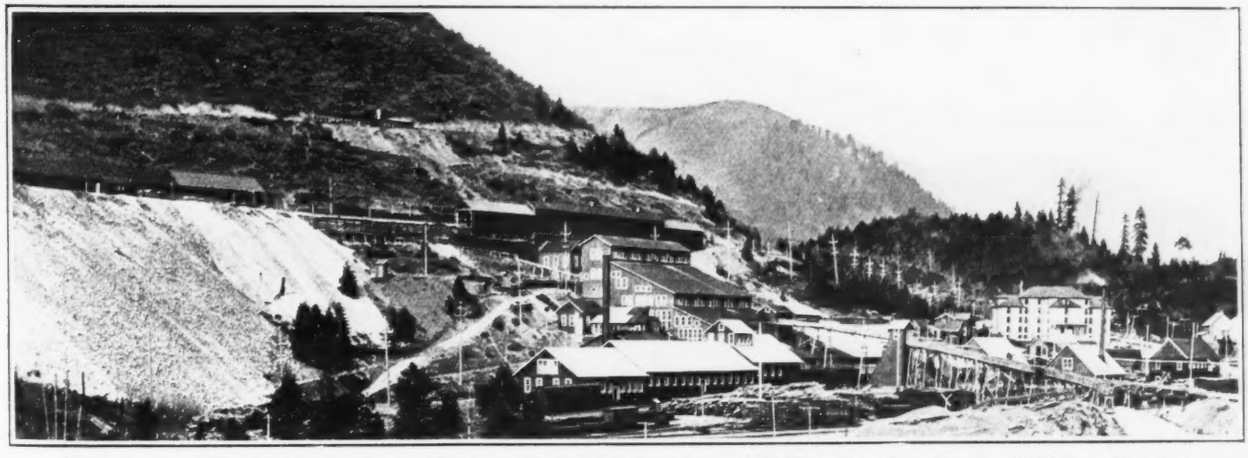
"The need for silver is appreciated by those in power in Europe. The potential market is there and it will continue to be there. But it is likely that in many instances special provisions and terms will be necessary in order to enable the governments involved to make the purchases. Poland, with which a contract for 6,000,000 oz. has been made, has no mints, and did not want to pay for the silver until it was delivered in the form of coins. So we worked out this plan: we send our silver to the Philadelphia mint; that mint will coin it at cost into the Polish coin worth about 19c. of our money, returning the coins to us as agent of the Polish Government. We will then ship them to Warsaw and draw against the Polish Government for the original cost of the silver and for the cost of minting and transportation. There will be installments of about 300,000 oz. a month, which is the capacity at present of the Philadelphia mint.

"Every day we carry the silver means loss of interest. If we had sold it to London or Shanghai we could get our pay at once. It may be three months, four months, or six months before the silver is delivered to Poland, and we have the money. We figure that the loss of interest, under the most favorable circumstances, will amount to nearly 1c. per ounce. In this instance, the loss is borne by the Anaconda Copper, the American Metal, the United States Smelting, Refining & Mining, and the American Smelting & Refining companies, which made the contract. These companies made this contribution to the cause of silver gladly, knowingly, because they believe sincerely that by so doing silver can again be placed in the currencies of Europe, that the silver industry of America will ultimately reap a reward in the higher price that must eventually follow. But it is pioneer work and it is expensive.

"There is every indication that Germany and several other countries may want to purchase further large amounts of silver. They may want us to fix a flat price on it. They may fear to buy on the open market from month to month or even on the average price of that month, because they may fear manipulation of the market and that they will be bidding up the price on themselves. Such contracts, made on a special basis to induce the coinage of silver, should be apportioned among producers in the approximate proportion of the output of each. The American Silver Producers' Association is in an ideal position to provide the machinery for such an allocation.

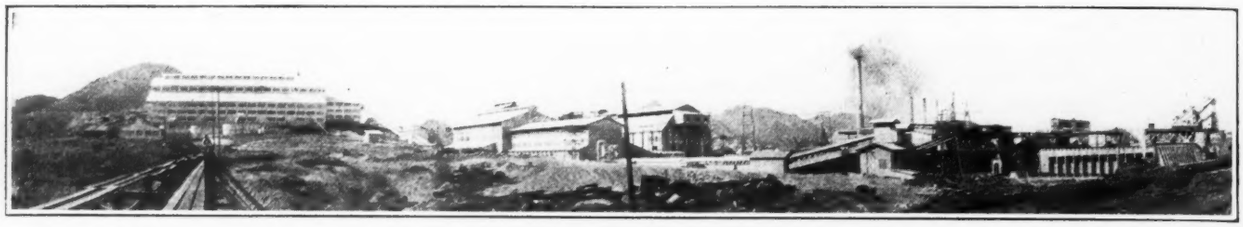
"Other problems in the negotiations and consumption of purchases of silver by these European governments surely will arise; to my mind, we are fortunate in having an organization that is so well able and that can so appropriately handle them as our newly formed Silver Producers' Association.

"I cannot come to any conclusion but that the day is not far in the future when silver will be restored to its former proud position of one of the two equally essential money metals: gold and silver. Not equal in value—the ratio between them will take care of itself—but equally necessary and important in the money system of the world. I have not the slightest fear as to the future of silver."



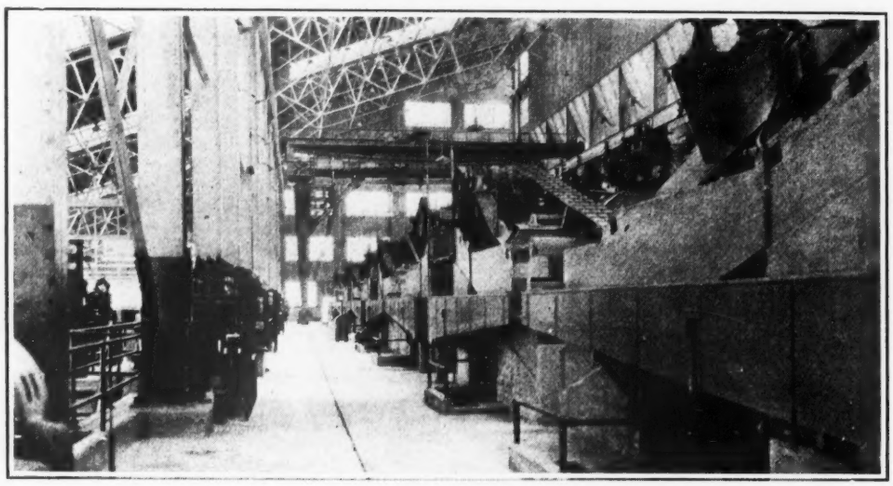
Morning mill of the Federal Mining & Smelting Co. at Mullan, in the Coeur d'Alene district of Idaho

The New Cornelia Concentrating Mill at Ajo, Arizona

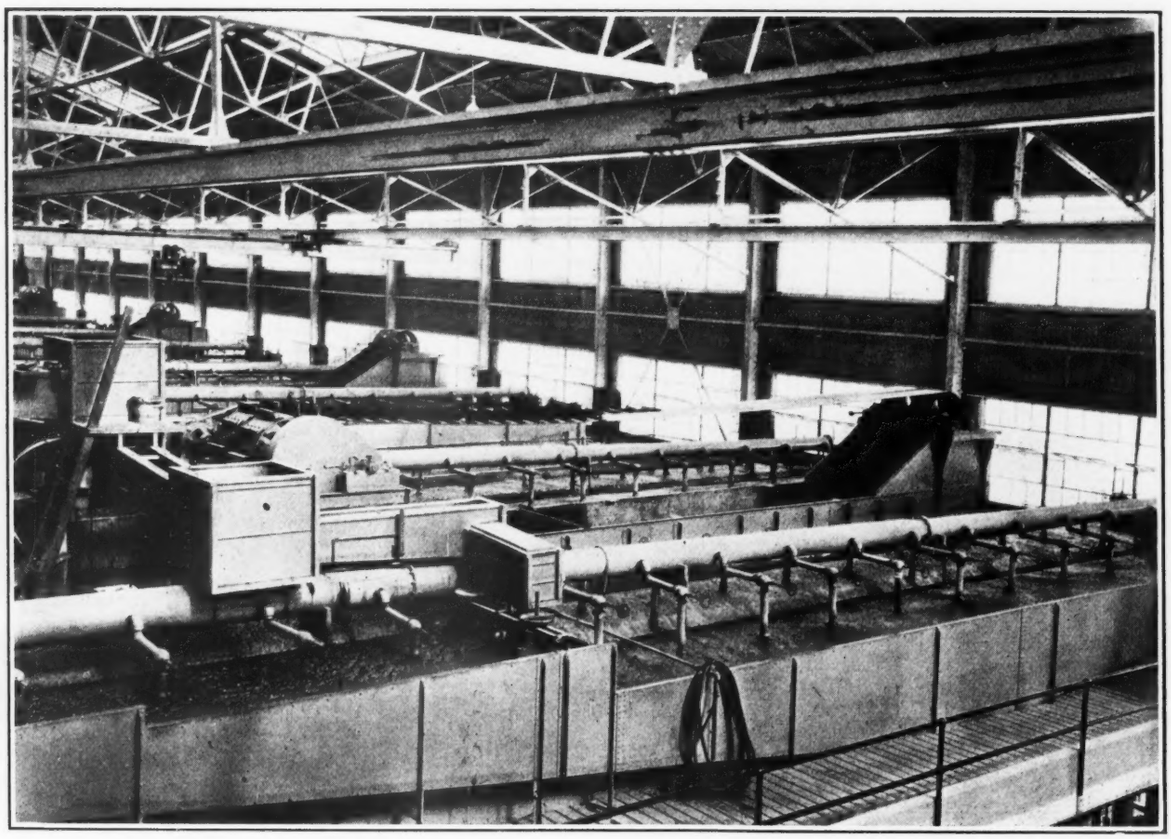


New Cornelia's surface plant

Recently built 5,000-ton concentrator, crushing units, power plant and refining department, leaching tanks with Hewlett unloader



Discharge launders of drag belt classifiers, with electrical controls at left and semi-gantry crane in background

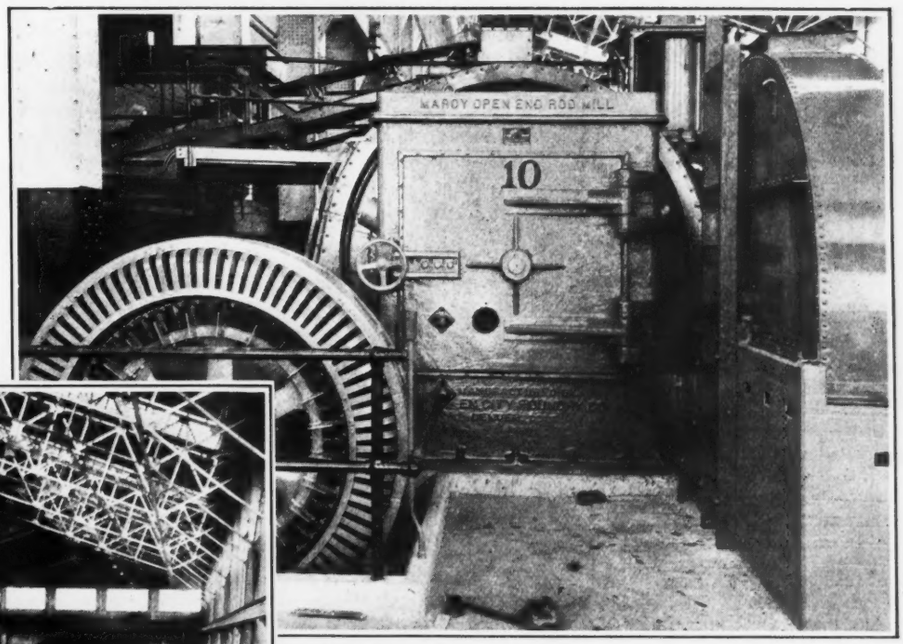


Pneumatic flotation machines, Inspiration type, with drag classifiers for handling the tailing

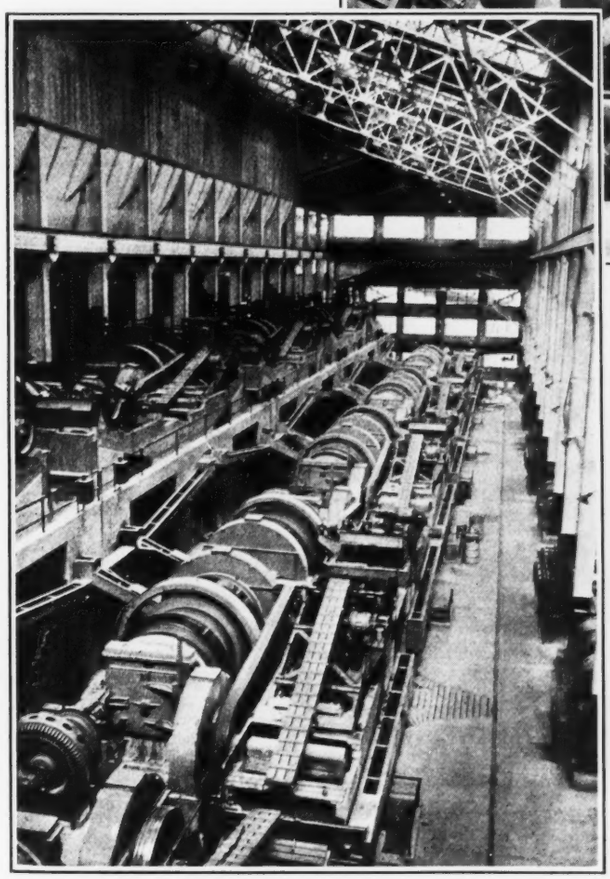
Exterior appearance of the 5,000-ton concentrator

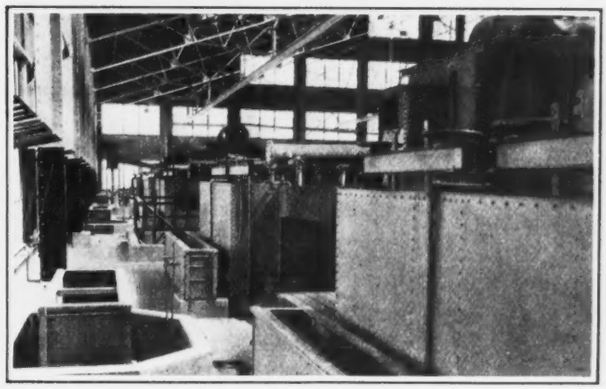
Ore is received from the open-pit operations one mile directly behind the concentrator, and is delivered in trains to the crushing plant at the right.

Below is shown the fine-grinding section, where twenty rod mills are installed. Each unit of the concentrator has two primary and two secondary mills, with corresponding duplex classifiers



Discharge end of rod mill, with scoop elevator at the right, and 175-hp. synchronous motor





Discharge end of flotation cells. Construction is of steel plate with wooden launders at the side. There are four cleaner cells and twelve rougher cells in tandem

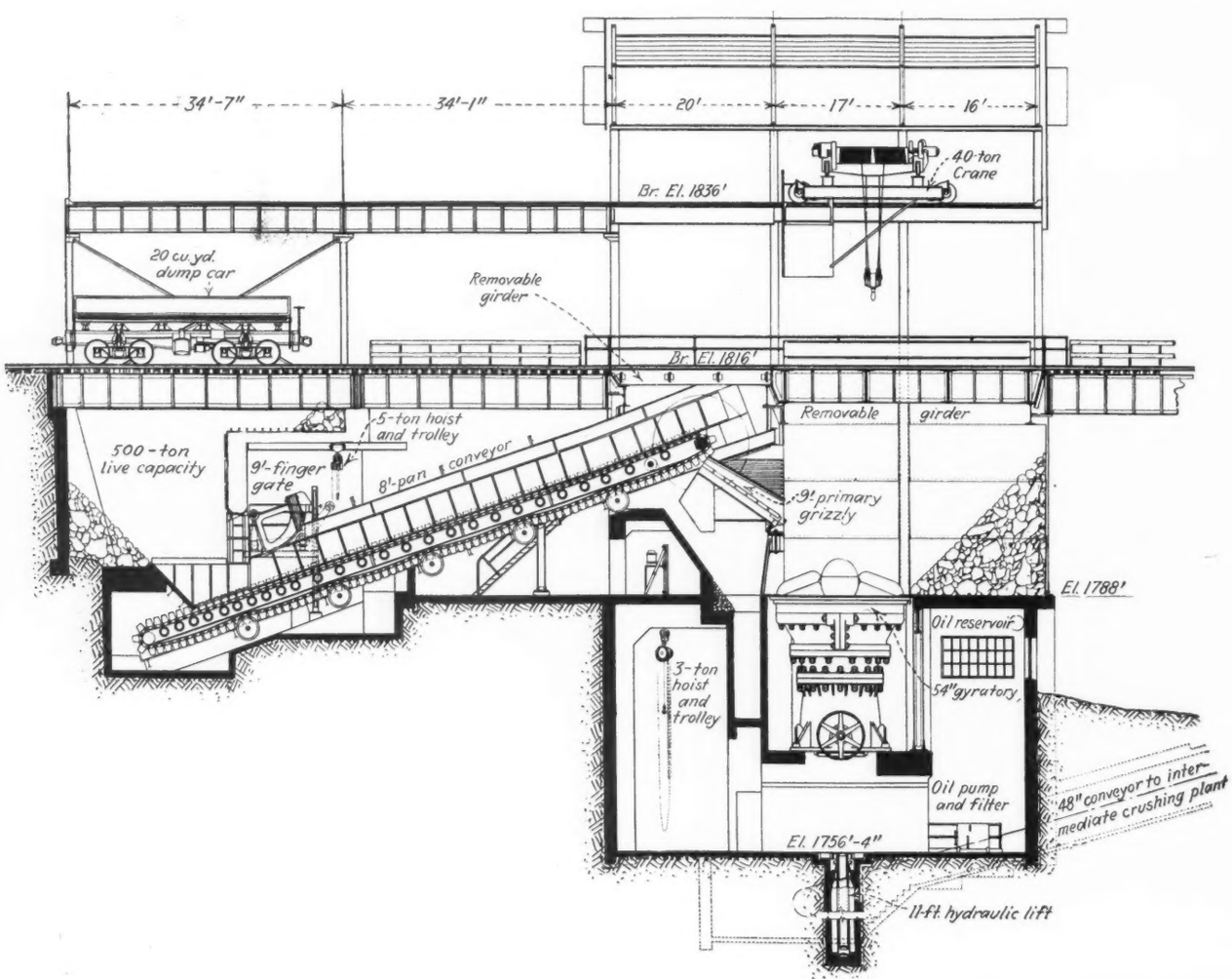
New Cornelia Concentrating Mill at Ajo, Arizona

Details of Construction of a Copper Flotation Plant That Embodies the Latest in Metallurgy and Engineering

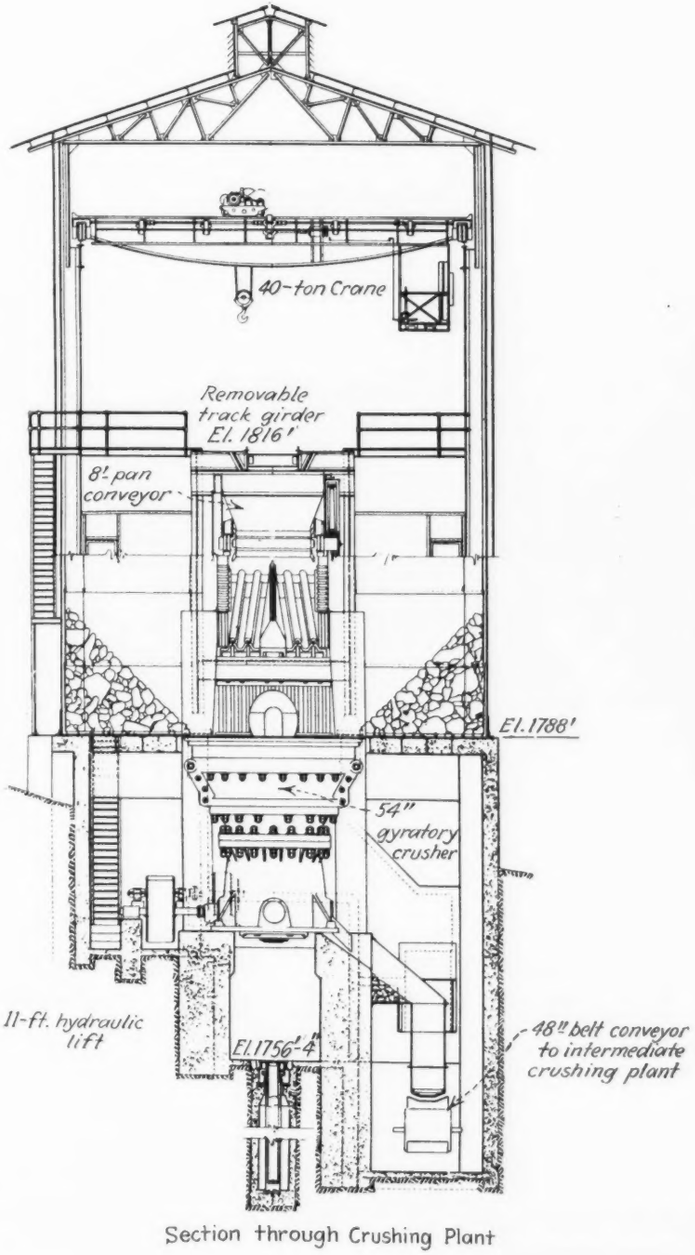
By H. Kenyon Burch
Consulting Engineer, Junior Orpheum Building, Los Angeles

THE LEACHING PLANT of the New Cornelia Copper Co., at Ajo, Ariz., in operation since April, 1916, has treated successfully the greater part of the oxide and carbonate ores, leaving a large body of sulphide ore partly exposed, to treat which a flotation concentrator has been built and recently put into operation.

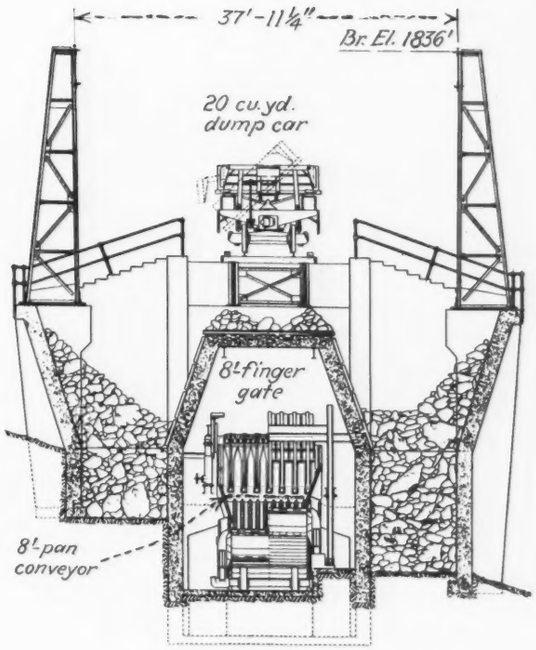
Test work in the experimental mill, from September, 1919, to February, 1920, inclusive, demonstrated the feasibility of flotation treatment for the sulphide ores as then developed; in June, 1922, I was given charge of the design of a 5,000-ton plant. At that time enough ore was developed to keep the leaching plant operating for about three and a half years at 5,000 tons per day. The construction of a 5,000-ton concentrator for treatment of sulphide ores, therefore, would give the company a treatment capacity of 10,000 tons, and provision was made in design and layout for increasing the capacity of the flotation plant to 10,000 tons per day after the leaching ores were exhausted. The problem, therefore, was complicated by the fact that one mine was producing two distinct ores, requiring approximately the same preliminary crushing. A decision was necessary as to the type of machinery to be adopted for a preliminary treatment that would give the most flexible arrangement during the life of the two plants, with the possibility of switching over certain of the equipment for crushing sulphide ores as the leaching ores became exhausted. It was finally decided to keep the preliminary crushing plants separate, although an arrange-



Coarse-crushing plant, longitudinal section



Section through Crushing Plant



Section through Receiving Hopper

Coarse-crushing plant, cross-section

ment of units was made that would allow the leaching-ore crushing plant to produce mill feed and to deliver it readily to the concentrator fine-ore belts should this seem desirable later.

The mill site selected, although favorable for the mill itself, necessitated the design of a complicated system of conveyors between it and the crushing plant. It was necessary to consider the present railroad from the mine, the power-house location, concentrate shipping tracks, accessibility to present plant equipment in general and possible future interchangeability of the two fine-crushing plants, in addition to the natural geographic features. As finally arranged, all elevation of dry material is by belt or pan conveyor, air lifts and centrifugal pumps being used for elevating pulp and water.

The present mine equipment consists of six 105-ton steam shovels, which load the ore into 20-yd. standard-gage side-dumping cars; and additional equipment of the same type and make was purchased to handle the sulphide ores. The ore is dumped from the cars at the coarse-crushing plant into a receiving hopper having a capacity of about 500 tons. The discharge opening from this is equipped with a finger gate having an opening 9 ft. wide by a maximum height of 8½ ft., and the ore is drawn from the hopper by an 8-ft. pan conveyor, which delivers to a grizzly ahead of the primary crusher.

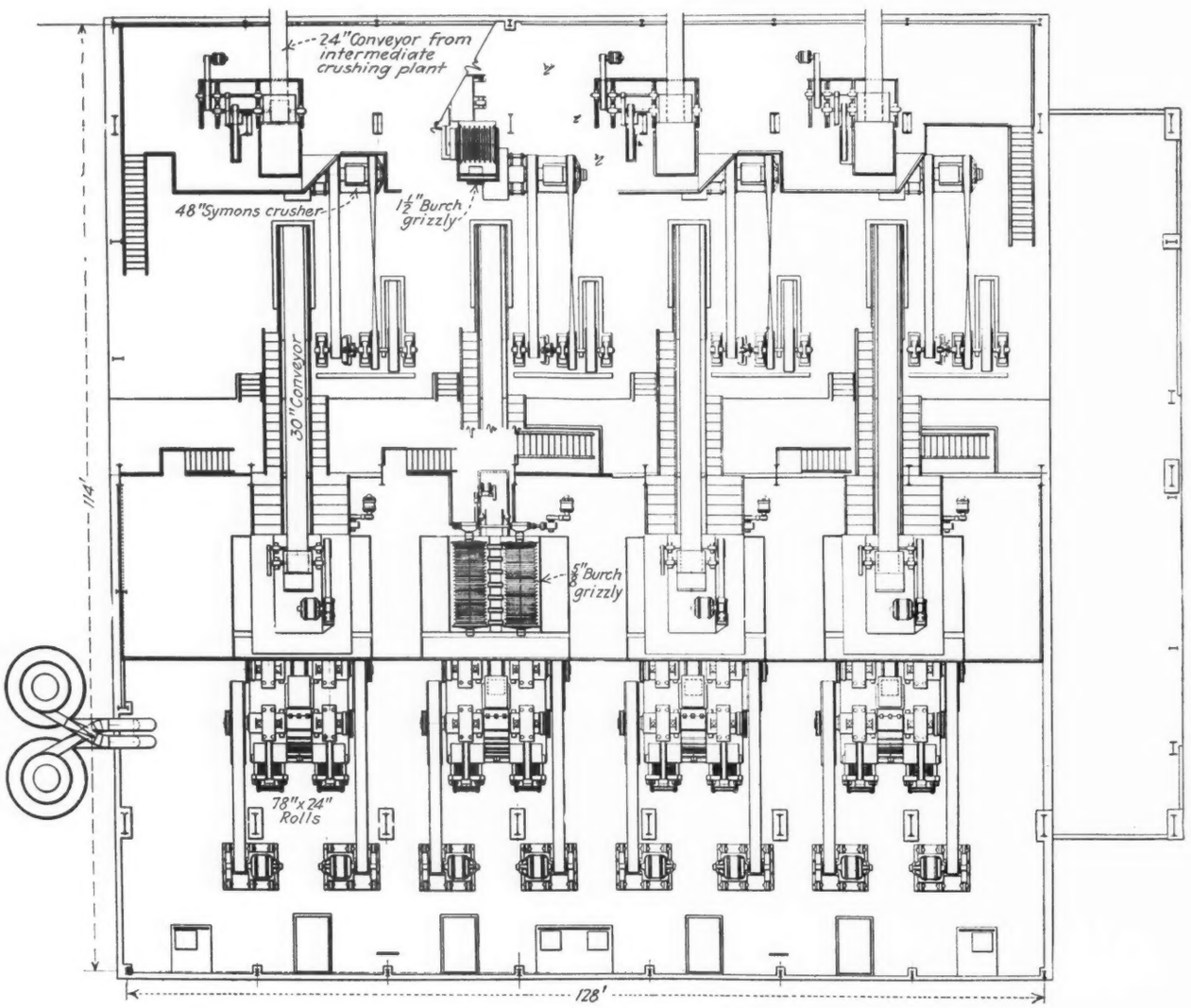
The pan conveyor discharges onto a 5-in. grizzly set at a slope of 37 deg., with its lower end at such a height that the ore is delivered approximately at the center of the bowl of a 54-in. gyratory. The grizzly bars, 15-in. I-beams 11 ft. 6 in. long, are equipped with cast-steel shoes 3 in. thick, with projecting lugs that engage the top flange of the beam. There are four of

these beams with a large cast-steel spreader on the center line of the grizzly, with two beams on each side. This spreader projects above the top of the grizzly about 2 ft. at the lower end and is of tapered section, the purpose being to split the ore stream and divert the larger pieces directly into the bowl of the crusher, thus affording protection to the cap and spider arms. The gyratory crusher is of the short-shaft type and is driven by a 250-hp. motor, operating at 500 r.p.m. The undersize from the grizzly and the crusher product is delivered to a 48-in. conveyor belt operating at 450 ft. per minute and delivering to a 42-in. tripper conveyor belt operating over the top of the intermediate storage bins. The 48-in. belt has a slope of 15 deg. and is operated by a 100-hp. motor about 100 ft. from the lower end of the belt. This motor and drive are installed in the motor house, built on the ground with adequate piers and foundations, to avoid the necessity of putting such heavy equipment in the conveyor headhouse. A gravity take-up is provided, with concrete counterweight, to maintain uniform tension in the conveyor belt.

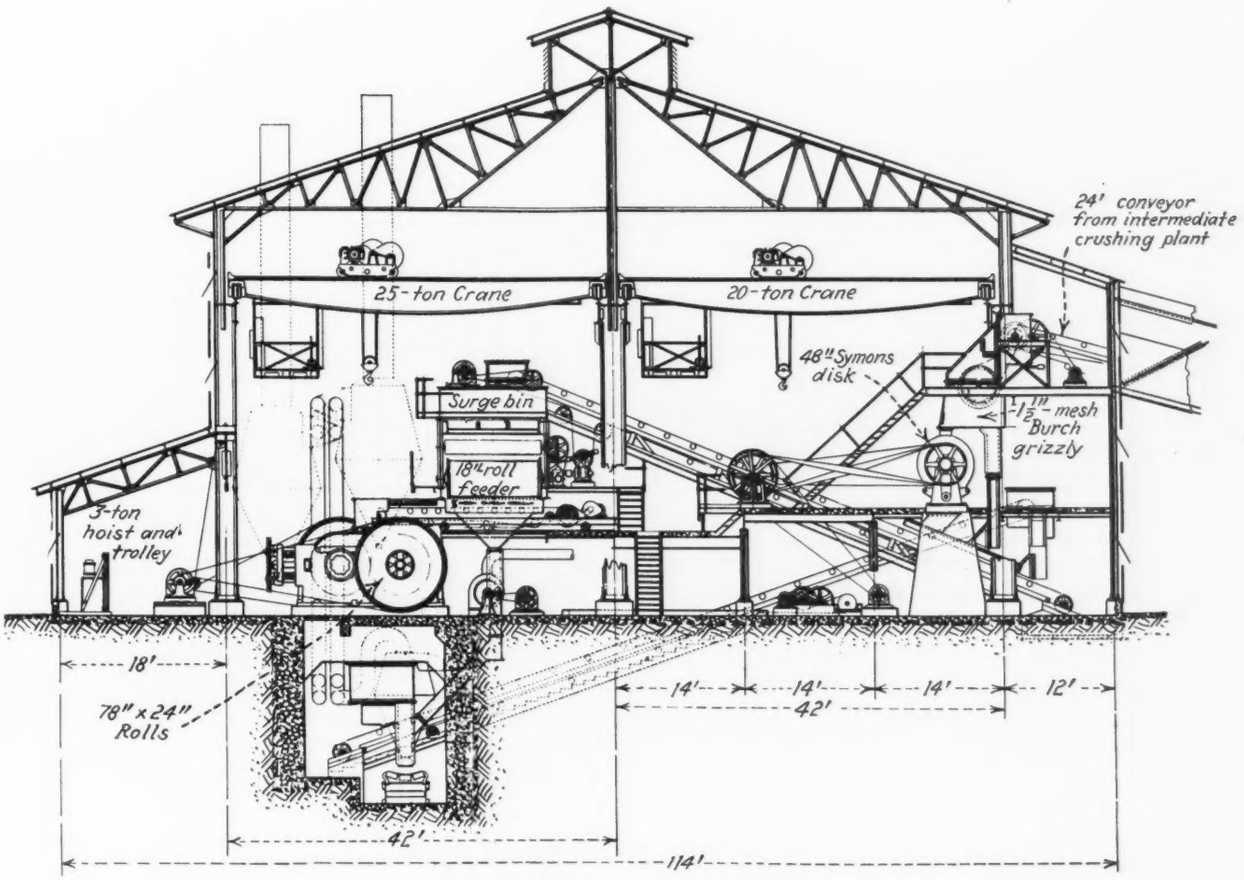
The tripper conveyor belt is driven from the head end by a 15-hp. motor and is equipped with a motor-driven, self-reversing, double-spout tripper traveling the length of the bin, which has a nominal capacity of 5,000 tons and consists of a steel structure on top of a concrete slab about 16 ft. above the ground line. This slab is 42 ft. wide by 116 ft. long; the shell of the bin consists of vertical steel columns spaced 24 ft. apart, the sides of the bin being of bent plate. There are four units in the intermediate crushing plant, each consisting of two 48-in. pan feeders, built into the bottom of the bin, feeding on to one 36-in. belt, which in turn delivers ore to the revolving-ring grizzly ahead of the No. 8 gyratory crusher. These feeders are driven by a belt from the tail pulley of the conveyor, and the feeder conveyor and grizzly are both driven from one variable-speed, 7½-hp. motor.

The No. 8 gyratory crusher is driven by a 75-hp. motor and delivers its product, together with the undersize from the revolving-ring grizzly, to a 24-in. conveyor belt, which delivers the ore to the corresponding unit of the fine-crushing plant. This conveyor is about 170 ft. long, operates at a speed of 300 ft. per minute, and is driven by a 15-hp. motor.

Each of the four units of the fine-crushing plant consists of a 48-in. horizontal-shaft disk crusher and one set of 78x25-in. rolls, with the necessary conveyors and grizzlies. The conveyor from the intermediate



Plan of the fine-crushing plant



Fine-crushing plant, cross-section

crushing plant discharges to a 1½-in. revolving-ring grizzly, the oversize from this constituting the feed for the disk crusher. The undersize from the grizzly, together with the product from the disk crusher, is delivered to a 30-in. incline conveyor belt operating at a speed of 330 ft. per minute, delivering the ore to a pair of ⅝-in. ring grizzlies. The undersize from these goes directly to the mill bins, and the oversize is delivered to the rolls by means of a 24-in. shuttle conveyor. These rolls operate in closed circuit with the grizzlies, and their product is delivered by a 24-in. incline conveyor operating at 330 ft. per minute onto the conveyor handling the disk-crushing product. The shuttle conveyor is mounted on a frame in such a manner that it can be readily moved out of the way when repairs to the rolls are necessary. The frame is mounted on wheels operating on a track built into the floor, and the forward portion of the shuttle frame extends well beyond the edge of the floor and engages the feed chute of the rolls when in the operating position. Thus by disconnecting the dust-collecting pipe, the frame and conveyor can be rolled back. The conveyor is driven from the tail pulley, which, together with the back-geared motor and drive mechanism, is mounted on a separate platform, with sliding ways and tension screws for taking up the slack in the belt.

Each unit of the fine-crushing plant is equipped with a dust collector system, consisting of an exhaust fan and a dry collector discharging onto the main conveyor belt going to the mill bins. In addition, two wet collectors are provided outside of the building to handle the exhaust from the four dry collectors. The dust from these secondary wet collectors is also delivered to the above-mentioned conveyor system. Suction pipes are provided at all points of delivery to and from the conveyors and crushing units. The chutes and hoppers are all tightly inclosed, and the openings for the passage of ore are restricted as much as possible, to insure a positive inflow of air at each of these points to prevent the escape of dust into the open spaces of the crushing plant and to improve operating conditions. The ore is unusually dry and dusty.

The final product of the four units of the fine-crushing plant is delivered to the mill-bin conveyor system, consisting of three conveyors having a total length of about 1,200 ft. and a total elevation of about 75 ft. The first of these is 42 in. wide and 325 ft. long and operates at a speed of 400 ft. per minute. Approximately 100 ft. is horizontal in the tunnel below the rolls, from which point it ascends at a slope of 17 deg. to the motor-drive house, where it discharges onto a 48-in. conveyor, about 400 ft. long, operating at 450 ft. per minute and running at an incline of 15 deg.

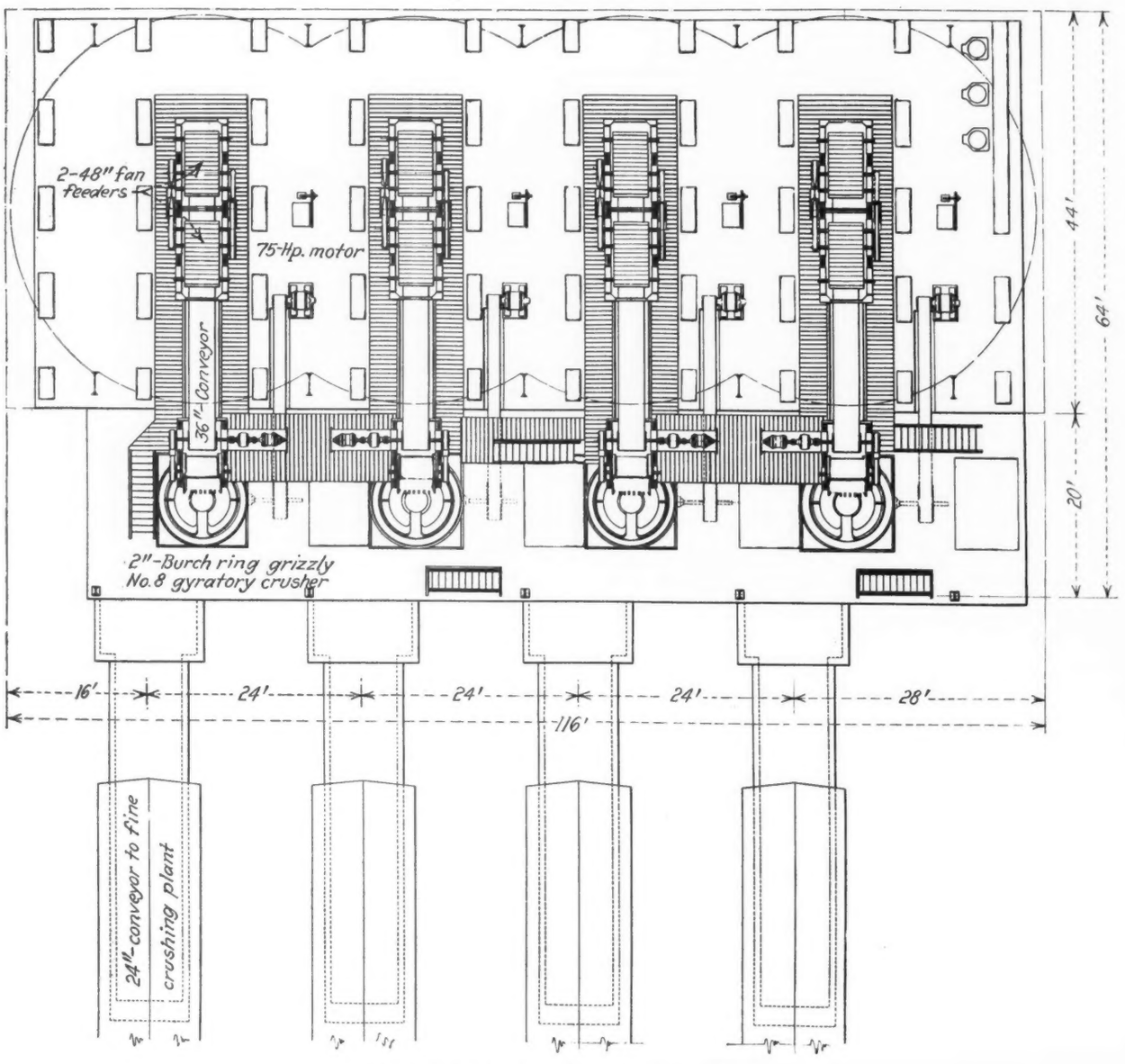
These two conveyors are driven by one 250-hp. motor, the drives being on the ground, as with the No. 2 conveyor from the coarse-crushing plant to the intermediate bin. At the upper end of the 48-in. conveyor the ore stream makes a right-angle turn having a drop of about 9 ft. onto the third conveyor of the system. This is 42 in. wide and 450 ft. long and ascends a 15-deg. slope for about 140 ft. until it reaches the top of the mill ore bins. This conveyor is driven by a 100-hp. motor and is equipped with a motor-driven, self-reversing tripper, which is a duplicate of that on the No. 3

conveyor over the intermediate bin, except that the spout is narrower than required for the coarse ore handled by the No. 3 conveyor. This conveyor system has a maximum capacity at the speed given of 900 tons per hour, and delivers ore into the 10,000-ton mill bin, from which it is fed to the wet-grinding mills.

Suspension-Type Bin a Feature of Storage System

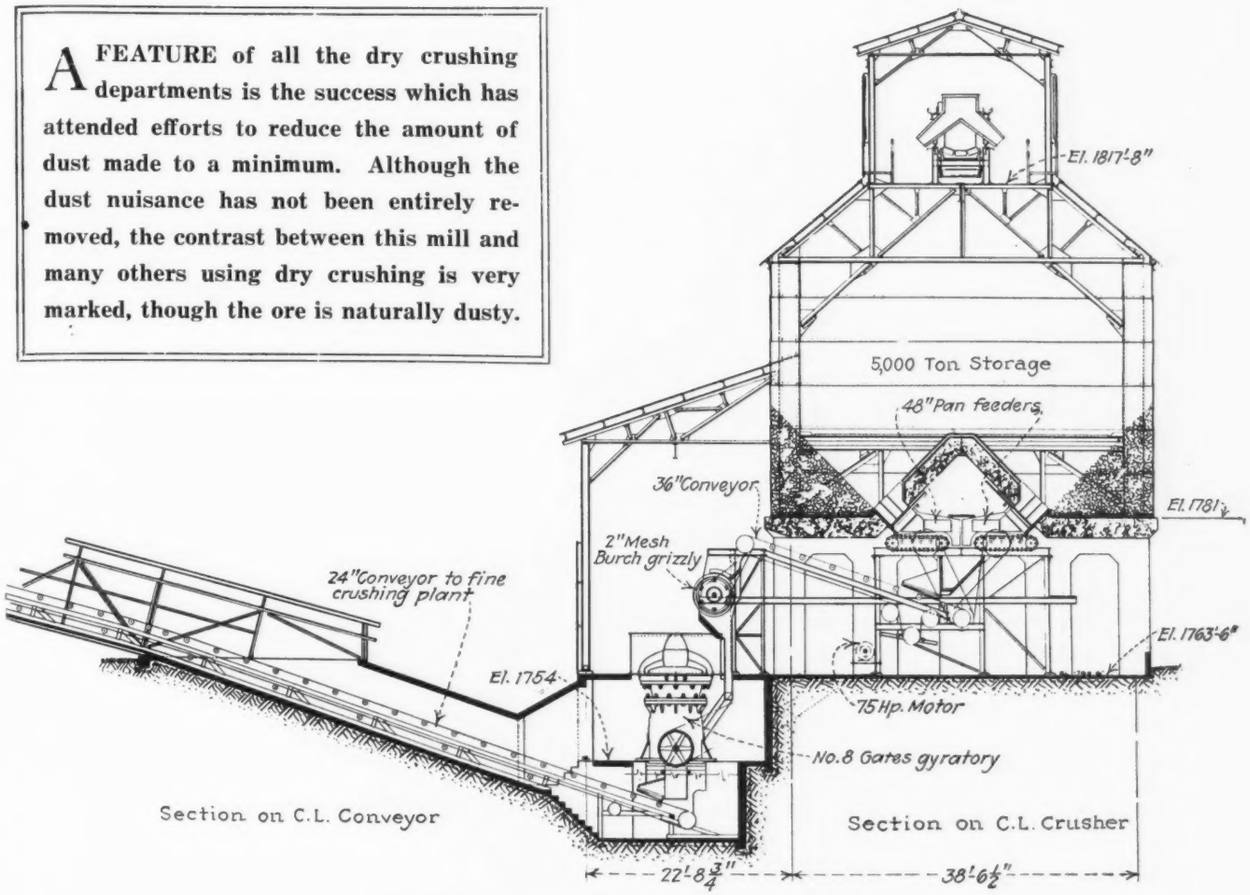
The mill bin is of the suspension-bunker type, the supporting columns being 32 ft. apart and spaced at 20 ft. centers longitudinally. The total depth of the bin from the top of the tripper rail to the bottom of the bin is 34 ft. and the capacity is about 33 tons per lineal foot of length. The storage space of the No. 1 unit is partitioned from the remainder of the bin, so that this may be used for experimental work, or for the treatment of a special ore that may thus be kept separate from the feed of the other units.

The top edge of the side plates is reinforced as a girder flange, and the horizontal stress is taken up by the bottom cord of the truss which supports the tripper track. Discharge hoppers are spaced 10 ft. apart throughout the length of the bin, and each group of three hoppers feeds a belt conveyor feeder which delivers to a hopper at the center line of each unit. Each discharge hopper is equipped with a rack and pinion gate, easily adjustable for the proper discharge; and the framework supporting each belt feeder is hung from the bottom of the bin by four rods with turnbuckles for vertical adjustment. This provision is made to compensate for the movement of the bin under varying conditions of load, so that the bottom and the feeders move as a unit. Each of the feeders is driven by a 2-hp. variable-speed motor, supported on the framework described and operating through a spur-gear reducer to give a nominal speed of 30 ft. per minute to the belt feeder. Under normal operating conditions, the tripper will distribute the ore uniformly throughout the entire length of the bin, so that the ore drawn from any given pocket will be practically uniform with that drawn from any other pocket. When



Plan of the intermediate crushing plant

A FEATURE of all the dry crushing departments is the success which has attended efforts to reduce the amount of dust made to a minimum. Although the dust nuisance has not been entirely removed, the contrast between this mill and many others using dry crushing is very marked, though the ore is naturally dusty.



Cross-section of the intermediate crushing plant

the feeders and gates are adjusted for proper height to secure a given rate of feed, any necessary adjustment in rate may be secured by the variable-speed motor. The two feeders in each unit discharge into a common loading hopper for a 24-in. conveyor, operating at 100 ft. per minute, equipped with a weightometer and delivering to the two primary rod mills.

Fine Grinding Done in Rod Mills

The rod mills, of which there are two primary and two secondary in each of the five concentrator units, are nominally 6x12 ft., being actually 6 ft. 6¾ in. inside diameter by 13 ft. long. The shell, of cast steel, is made in three sections, with flanges for bolting these together and also for bolting the end castings. The middle section is fitted with a spur gear; and the two end sections are fitted with chrome-steel riding rings, arranged symmetrically about the center line of the mill. The head castings are easily removable, so that the mill may be readily turned end for end, to compensate for unequal wear of the rods and liners should this occur. The riding rings are 14 in. face, and the rolls on which they are supported are 40 in. diameter. Bearings are 8½ in. diameter and 15 in. long, and are equipped with ball thrust bearings at each end of the roller shaft. The housing in which the bearings are supported is provided with an adjustable base, each pair of rolls being supported on a heavy cast-iron base bedded to the concrete foundation. Adjusting screws are provided so that the mill can be maintained in any required position by slight adjustment of the rollers. This allows a ready means of relieving the thrust rollers of undue wear, and also for changing the speed of the mill by changing the drive pinion, without the necessity of realigning the motor, clutch, and pinion shaft. Thus the mill would be moved on its sliding bases, to maintain proper contact with the gear, should the pinion be changed.

Two thrust rollers are provided, 3¼ in. thick and 19 in. diameter, arranged to prevent longitudinal movement of the mill by bearing against the riding tire. These are of heavy construction, supported on a vertical shaft, and operate in a bronze bushed bearing. The rod charge is nominally carried at about twenty-three tons of high-carbon steel rods, 3 in. or smaller in diameter by 12 ft. long when fed into the mill, but usually wearing down to about ⅝ in. diameter before going to waste. The mills are of the open-end type, and the door is supported by and hinged on a heavy cast-iron discharge box, which makes a neat and compact arrangement.

Each mill delivers its product to a 6x23 ft. duplex classifier, the primary ones being arranged to return all or a part of their sand to the feed end of the primary mill. Thus means are provided for equalizing the load between the primary and secondary mills when operating in tandem. Increased flexibility is also maintained: if a secondary mill is temporarily not in condition for operation, the primary mill normally operating with it can be put in closed circuit, provision being made at the discharge end of the feeder conveyor for splitting the feed in any desired proportion between

the two halves of the unit. If one primary mill is closed down, the other can take the entire unit feed, and its classifier sand can be divided between the two secondary mills of the unit. Thus three out of the four mills can always be kept in operation, so far as feeding arrangements are concerned. The secondary classifiers are operated in closed circuit, and their overflow joins the overflow of the primary classifiers, going to flotation. Each classifier is driven by a 7½-hp. motor, and is equipped with an extended drive shaft for operating the scoop for elevating the mill discharge.

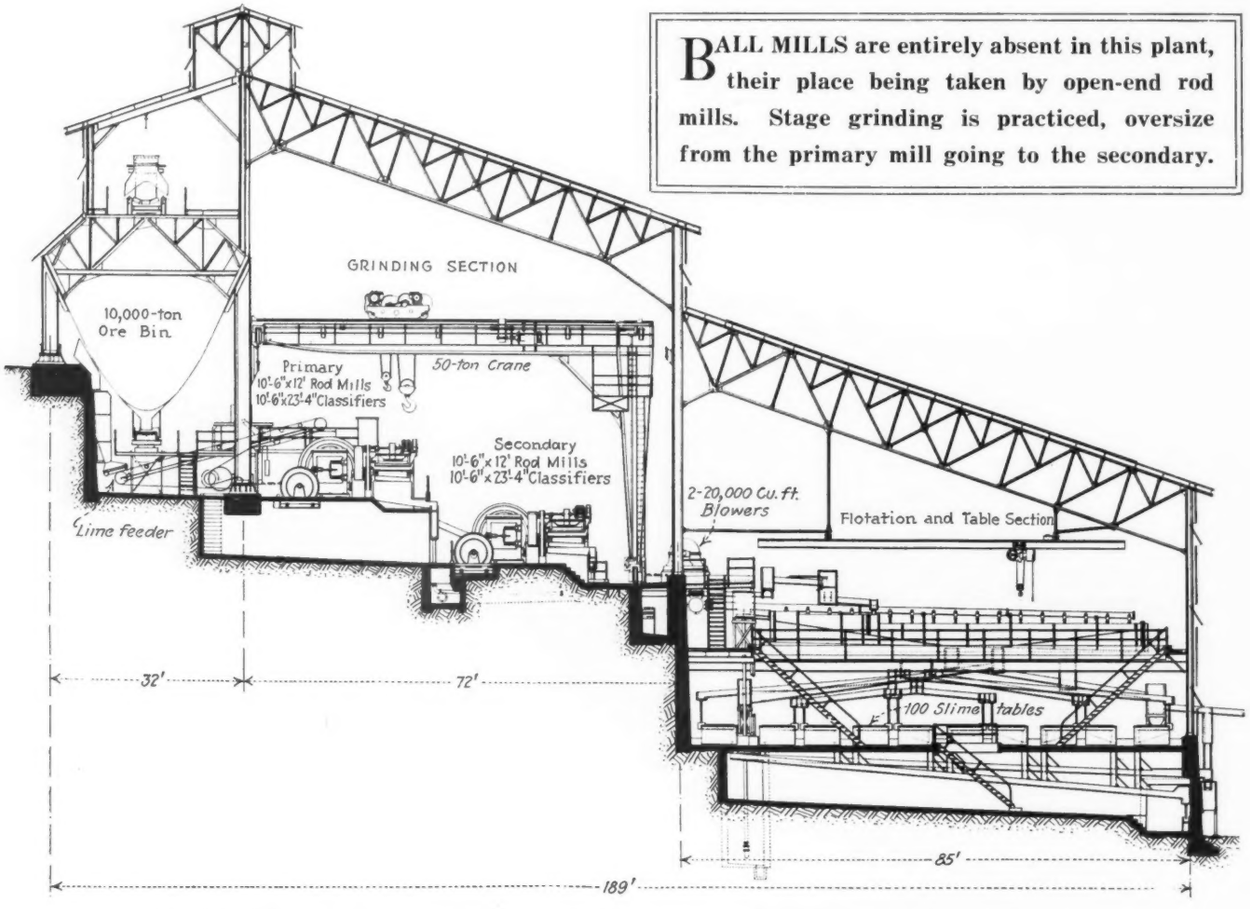
The flotation machines, of which there are two in each unit, are of the Inspiration type and consist of twenty-four rougher pans and eight cleaner pans each 3 ft. 9 in. x 3 ft. 6 in. Air is introduced from a header supported immediately above the machine, and the 2½-in. branch pipes to each pan are equipped with regulating valves easily accessible to the operator. The cleaner cells are at the upper end of the flotation box, so that the tailing goes direct to the rougher cells and the flotation feed is introduced into a compartment immediately ahead of the first rougher pan. This compartment is equipped with baffles for maintaining the correct height of the pulp in the cleaner cells and for distributing the pulp evenly to the rougher cells. These baffles are adjustable and are easily maintained in the correct position. The flotation rougher concentrate is returned to the cleaner cells by a 6-in. air lift for each machine; and provision is made for combining the concentrate from the first few roughers with that coming from the cleaner cells, as it has been found that part of the rougher concentrate does not require cleaning.

The flotation tailings from both machines are elevated to a drag classifier on the flotation balcony immediately between the two flotation machines, the overflow from which goes to the slime-tailing thickener, the sand being distributed to twenty tables immediately below the flotation balcony, for further treatment. The drag classifier is driven by a 7½-hp. variable-speed motor and has a nominal operating speed of 10 ft. per minute. The tables are driven by individual 1-hp. back-geared motors, and operate at 290 strokes per minute. Tailings go to the sand-tailing thickener and the concentrates from all five units go to a sump, from which they are pumped to the regrinding plant for re-treatment.

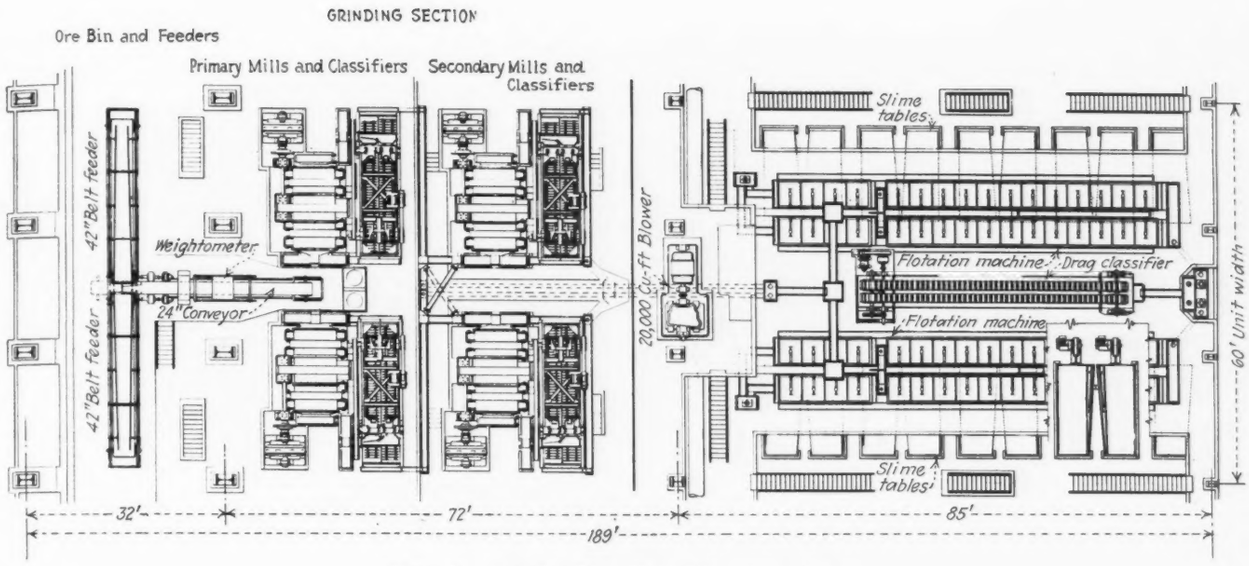
Either Ball or Rod Mill for Regrinding

Regrinding equipment consists of a ball mill and a rod mill, previously used in the experimental test plant. Either of these machines has sufficient capacity for the entire concentrator, one being held as a spare. The table concentrates are delivered to a 6x23-ft. classifier, having a water-tight partition extending between the two rakes, which in effect makes two classifiers of this machine. The finishing-table concentrate is received in one side of this classifier for dewatering, and the other side is used as a circulating classifier in closed circuit with the grinding mill. The overflow from the dewatering side joins the table tailing and goes direct to sand tailing. The overflow from the circulating side of the classifier is elevated by a 3-in. air lift to a flotation machine, of four pans in the

BALL MILLS are entirely absent in this plant, their place being taken by open-end rod mills. Stage grinding is practiced, oversize from the primary mill going to the secondary.



Cross-section, showing relative elevations of various departments of the concentrator



Unit plan of the New Cornelia concentrator

rougher compartment and two in the cleaner. This machine utilizes the same type of pans as the main flotation units. The rougher concentrate is elevated to the cleaner cell by a 3-in. air lift, the cleaner concentrate being elevated by another air lift of the same size for delivery to the thickeners provided for the mill flotation concentrates.

The thickeners are 58 ft. diameter by 8 ft. deep, and two are provided for parallel operation for each unit of the concentrator. Overflow goes to the return-water pump sump, and the thickened concentrate is collected in the pump sump for delivery to the filters. One additional tank, provided for resettling the thickened concentrate, is set at a sufficient elevation to deliver by gravity to the filter plant and also to return its overflow to the primary thickeners.

The tailing-sand thickener consists of a rectangular concrete tank, 20x60 ft. in plan, having a sloping bottom equipped with classifying cones. The overflow from this joins the slime overflow from the drag classifiers, for dewatering in a 200-ft. tank thickener, the sand going direct to tailing disposal, joining the sand from the 200-ft. tank. The overflow from the large tank goes by gravity to the return-water pump sump, where it joins the overflow of the concentrate thickeners and is returned to the mill.

The filter-plant and pump-house equipment consists of four 14x14-ft. continuous filters, with the necessary accessories. These deliver their product to a 24-in. conveyor belt, 375 ft. long, traveling at 15 ft. per minute, which discharges directly into shipping cars, for transportation to the reduction plant. The accessories in the filter plant consist of two 2,500-cu.ft. vacuum pumps, one being held as a spare; one 10-lb. compressor; two wet vacuum pumps, with moisture traps and receivers, and two centrifugal return-water pumps, one being held as a spare. The 10-lb. air receiver is also connected through a reducing valve with a 20-lb. air line from the concentrator, in case the filter plant compressor is not operating. This 20-lb. air is provided for operating the air lifts at the concentrator and is supplied by two 2,000-cu.ft. capacity compressors, in the regrinding plant, one being held as a spare.

The disposal of thickened tailing from the 200-ft. thickener and the sand thickener is by gravity through a launder about 4,400 ft. long to a pumping plant. The tailing is pumped by means of centrifugal sand pumps through woodstave pipe of a total length of about 5,000 ft. and delivered to the tailing distributing launder at two different points, the launder sloping in each direction from both. The total length of distributing launder at present built amounts to 5,500 ft. and has an estimated life of about three years at 5,000 tons' daily capacity. The total ultimate tailing area at present proposed is about 250 acres; as the level of the dump rises the distributing launders will be extended until they surround this area. It is planned to recover as much water as possible from the pond, and two belted centrifugal pumps are provided for returning water to the sump at the filter plant, where it will join with the overflow from the thickening tanks and be pumped back into the system.

The water supply comes from the well developed at the time the leaching plant was built. The pumping station is about 650 ft. below the surface of the ground and about 7 miles from the power plant. It was originally equipped with two 1,000-gal. plunger pumps, delivering water through a 10-in. line directly to a 500,000-gal. tank on the hill immediately above the concentrator site. One of these pumps is ordinarily held as a spare, and the total pumping head when one pump was operating through this line was 1,650 ft., the static head being 1,200 ft. To provide additional water, the pump station has been enlarged to accommodate a maximum of five more pumps, although only two have been installed under the present program. An additional shaft has been sunk, and increased facilities provided for handling a maximum of 5,000 gal. per minute. Extending below the level of the pump station at each shaft is a lifting sump, the new equipment consisting of three centrifugal deep-well pumps for delivering water to an overhead sump about 10 ft. above the main pumping station floor level, supplying the line pumps. These deep-well pumps are driven by vertical induction motors operating at 440 volts; the main lifting pumps, by synchronous motors operating at 72 r.p.m. and de-

livering water at the surface through a 14-in. line, to the new line from the well to the plant, which is 20 in. diameter and is connected to operate in parallel with the 10-in. line as originally installed. This 20-in. line is laid on a continuously ascending slope, to avoid the formation of air pockets; and the lengths of pipe are connected by Dayton couplings—a compression coupling fitted with rubber gaskets, easily installed and apparently very satisfactory. There are about 1,700 couplings in this line; to date no leaks have developed and it has not been necessary to tighten any of the joints.

Water is delivered into the power-plant cooling-pond sump, from which the mill water is re-elevated by 2,000-gal. per minute centrifugal pumps to the mill reservoir. To avoid contamination by the cooling pond, provision is made for re-pumping domestic water direct from the cooling-pond sump to the domestic water tank originally supplied by the 10-in. line direct from the well. This line can still be used separately from the 20-in. line if considered advisable. A V-notch meter is provided at the reservoir for recording the amount of water received.

The reservoir, with a capacity of about 1,000,000 gal., is situated on the hill immediately above the concentrator. The site was carefully investigated and the excavation made during construction, the rock being used for the concrete needed in the plant. After completion of the concrete work and the storage of sufficient rock to take care of immediate requirements, the reservoir was lined with concrete and made ready to receive water. The fresh-water line from the reservoir to the concentrator is 16 in. diameter and is connected directly to the return-water pumps in the filter plant, with branches at each of the different levels of the concentrator.

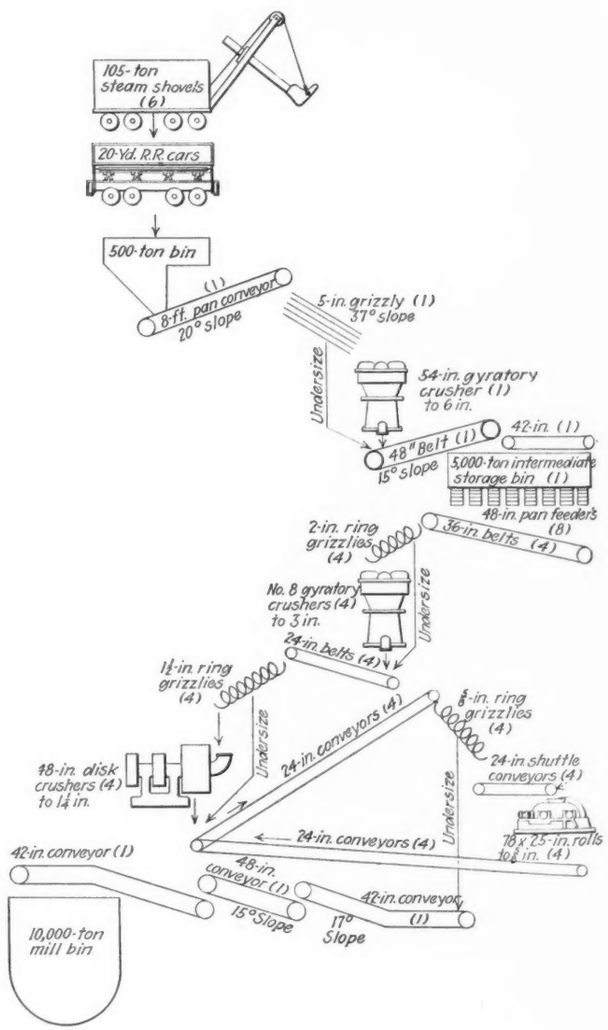
How the Electric Power Is Distributed

Electric power comes from the power house as originally built for the leaching plant, where it is generated at 2,300 volts, 3 phase, 60 cycles. The transmission line from the power house to a substation at the concentrator consists of six 3-wire circuits, two of which serve the intermediate- and fine-crushing plants and are rated at 1,250 kva. each, and four of which go directly to the concentrator substation and are rated at 1,500 kva. each. This line is built on steel towers through the yard and crosses the scrap-iron precipitation vats. As this material is handled by a locomotive crane having a 45-ft. boom, the steel towers are unusually high, the line being 65 ft. above the ground at this point. The tower line makes a right-angle turn after passing the fine-crushing plant, the corner tower being heavily anchored and braced. The cables, which are of 400,000 and 500,000 circular mill section, are carried on suspension insulators at this point, as well as at the ends of the line.

At the concentrator substation the four circuits are tied into a common bus through 600-ampere, manually operated, remote-control switches, with 15,000 amperes rupturing capacity. These incoming panels are equipped with reverse-power relays, to prevent a rush of current in an opposite direction in case of a short circuit. A spare panel and switch are provided, the latter for connection to the incoming and distributing bus by disconnecting switches if it is necessary to cut out one of the switches for repairs or adjustments. This bus-tie panel carries the polyphase watt-hour meter for totalizing the load, the switchboard volt-meter, and the power-factor meter.

Power at 2,300 volts is distributed to each unit of the concentrator, to the filter plant and regrinding plant, and to the lighting and the 400-volt power transformers, a control panel being provided for each circuit, with totalizing and indicating meters to provide for a ready distribution of power for accounting purposes. All motors of 25 hp. and above are 2,200 volts, smaller ones being 440 volts. The 440-volt transformers for concentrator power and the 110-volt transformers for concentrator lighting are immediately adjacent to the substation, and the 440-volt distributing panels are mounted in the same group with the 2,200-volt panels. The lighting current is carried direct to an inclosed, safety-type, 7-circuit panel box with 3-wire mains and branches, from which it is distributed to seven 10-circuit panel boxes with 2-wire branches.

The power distributing cables from the substation are 3-conductor, lead-covered cables and are carried into the concentrator through a tunnel immediately below the secondary mill floor. At each unit one conductor of each voltage goes to a distributing switchboard in the case of the 2,200-volt power, and a junction box in


105-ton steam shovels (6)
20-Yd. R.R. cars
500-ton bin
(1) 8-ft. pan conveyor 20° slope
5-in. grizzly (1) 37° slope
Undersize
54-in. gyratory crusher (1) to 6 in.
42-in. (1)
48" Belt (1) 15° slope
5,000-ton intermediate storage bin (1)
48-in. pan feeders (8)
2-in. ring grizzlies (4)
36-in. belts (4)
No. 8 gyratory crushers (4) to 3 in.
24-in. belts (4)
1¼-in. ring grizzlies (4)
8-in. ring grizzlies (4)
24-in. conveyors (4)
48-in. disk crushers (4) to 1¼ in.
24-in. shuttle conveyors (4)
24-in. conveyors (4)
78 x 25-in. rolls to ⅝ in. (4)
42-in. conveyor (1)
48-in. conveyor (1)
42-in. conveyor (1)
15° Slope
17° Slope
10,000-ton mill bin

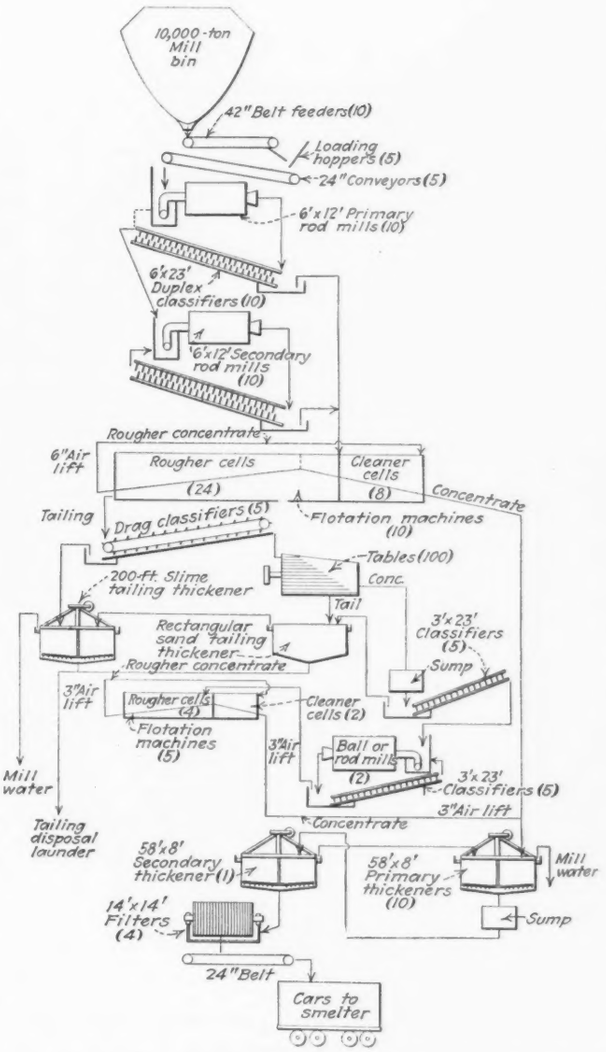
Flow sheet of the primary, intermediate, and fine-crushing departments, omitting details

case of the 440-volt power. The 6-panel switchboard of each unit consists of an incoming panel, four control panels for the four mill motors, and one for the 50-kw. motor-generator set. The incoming panel mounts the oil circuit breaker used as a unit disconnecting switch, and the unit power-factor meter. Each of the mill-motor panels mounts an electrically operated, manually controlled oil circuit breaker for throwing the motor directly on the line. A polyphase graphic meter and a watt-hour meter are provided for each motor, together with a field ammeter and resistance, and the necessary low-voltage and overload relays. The graphic meter gives a continuous record of mill performance that often proves valuable. The motor generator is also thrown directly on the line, and in addition to the circuit breaker its control panel is provided with direct-current voltmeter and ammeter, rheostat mounting and the necessary switches and transformers. Indicating wattmeters for each mill are mounted apart from the control panel, where they are easily visible to the operator on the primary-mill floor. This provides an indication of the amount of work being done by all four mills, an unbalanced condition being readily adjusted by regulating the feed to any or all of the mills.

Synchronous Motors Now Used for Rod Mills

The rod-mill motors are synchronous, of 175 hp., and operate at a speed of 150 r.p.m. As there are four of these in each unit and two 650-hp. synchronous motors driving the blowers for the entire mill, a total of 4,800-hp. of synchronous motors is available in the concentrator. This gives an extremely high power factor; and, as the well motors are almost all synchronous motors, the total power-plant load is maintained at a high power factor. Previous installations of rod mills made under my direction were equipped with high-speed induction motors, operating through a speed reducer, in which the loss of efficiency probably offsets the increased efficiency of the high-speed motor. The present installation, with magnetic clutches, provides a highly efficient drive, and one that is rapidly finding favor among mill designers, on account of the high power factor obtainable. Except the mill motors, all motors throughout the plant above 2 hp. are equipped with full automatic control, with stop and start buttons at convenient places. The mill motors are started by means of a manually controlled switch at the unit-control panel, as previously mentioned; the magnetic clutch is provided with an automatic starter controlled by a push button at the mill motor. The clutch-magnetizing current is on an interlock with the motor control, to insure the clutch being open when the motor is started. Thus it is impossible to close the clutch circuit until the motor is operating in synchronism.

The two blower motors for flotation air operate at 3,600 r.p.m. and are each direct-connected to a two-stage blower having a capacity of 20,000 cu.ft. of air per minute. The control, full automatic, with push buttons for starting and stopping, is provided with all meters and accessories as mentioned above, except the graphic meters. The field current is obtained from the unit-motor-generator sets, as in the case of the mill motors. The blower units are on balconies at the secondary-mill floor level, and their inlets are connected into the tunnel immediately below the floor, which serves as a conduit for power distribution through the mill. This provides good circulation of air around these conductors, tending to keep the temperature low. The blowers discharge into a header immediately below the platform that extends the full length of the mill; and the blower output is controlled by discharge gates between the blowers and the header.



Flow sheet of the fine-grinding and concentrating departments

The tables have not so far been installed, the rougher tailings from the primary flotation machines going direct to the sand tank, and thence to the 200-ft. thickener, from which they are discarded. This simplifies the flow sheet on the present ore markedly.

The 440-volt power for each unit, as mentioned, is distributed from a junction box, where it is divided into three circuits. The first of these serves the mill feeders and conveyors, the former operated by 2-hp. variable-speed motors and controlled by a snap switch with fuse protection for overload. Low-voltage protection is secured by connecting these motors on the motor side of the 5-hp. automatic starter controlling the mill-conveyor drive. This not only gives the desired low-voltage protection, but also provides an interlock that insures the operation of the mill conveyor receiving the feeder discharge, before the feeders can be started. The flotation-oil feeders are also fed from this first circuit. The second circuit supplies the drag classifier, and the third circuit supplies the tables. There are

twenty of these tables in each unit, arranged in two groups of ten, each group being controlled by an automatic group switch, which provides low-voltage protection for the table motors, each of which in turn is controlled by a snap switch with fuse protection for overload. In unit No. 5, in addition to the three circuits mentioned, a circuit covers the oil-filter motors, which will be discussed later. Unit No. 5 also differs from the other units in that meters are provided for each of these circuits, to give a complete distribution of unit 440-volt power for accounting purposes.

Power is supplied to the filter plant at 2,200 volts, from its individual distributing panel in the substation, and is distributed at the filter plant from a switchboard consisting of a control panel for each of the 2,200-volt motors; 440-volt power for the filter plant and concentrate handling system is provided from a small bank of transformers in the filter plant; and lighting for the filter plant is also provided by its individual bank of lighting transformers. The regrinding plant has its separate switchboard and circuit from the substation; and the shops and cranes are combined into one 440-volt circuit.

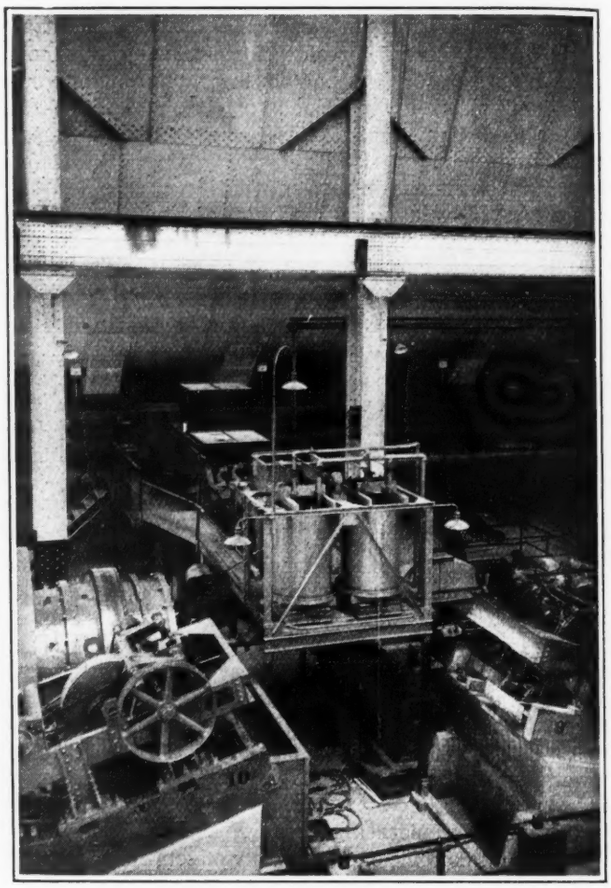
Of the two 1,250-kva. power circuits from the power house, as previously mentioned, the one to the fine-crushing plant supplies 2,200-volt power in the fine-crushing plant only, whereas the one to the intermediate plant supplies not only 2,200-volt power for the coarse and intermediate plants and for a portion of the conveyor system but also 440-volt power and 110-volt lighting for all three crushing plants. These transformers are under the intermediate-bin platform; and a junction box is provided for distribution of 440-volt power to the three plants.

Power to Pumping Plant at 44,000 Volts

Power for the well pumps is transmitted at 44,000 volts over the line provided when the plant was built. At that time 6,600-volt transformers were provided, but on account of increased load it was necessary to raise the voltage or rebuild the line. Accordingly, transformers of the higher voltage and of the necessary capacity were provided at the power plant for stepping up from 2,200 to 44,000 volts and stepping down again at the well to 440 volts, the original installation of pumps having been made at this voltage. Four single-phase, water-cooled transformers are provided for each transformer bank, one being held as a spare, each of 833 kva. capacity, providing ample power for the maximum requirements of the plant. It was necessary, to change over the line to the higher voltage, to provide new crossarms and insulators, and these were installed while the line was operating at 6,600 volts. Power is carried from the well-transformer station down the shaft by means of flame-proof, single-conductor cables; and each synchronous motor is provided with its individual motor-generator set.

Several features in connection with this plant will be given special mention. The first is the 8-ft. pan conveyor and accessories mentioned in the description of the coarse-crushing plant. One of the first principles in the design of plants of this nature and one of the essentials for successful operation is that the crushing units be supplied with a constant feed, to insure maximum efficiency. As the ore arrives at the crushing plant from the mine in six-car trains, at irregular intervals, the receiving hopper provides a surge bin that takes care of this irregular feed, and the pan conveyor delivers it to the primary crusher at a uniform rate.

The bottom of the hopper is arranged so that a part of the weight of the ore is taken directly by the pan



In the rod-mill section. The reagent distributors are in the center, and a weighing machine and ore bin at the back

conveyor, and an automatic device is provided to prevent the operation of the conveyor motor when the bed of ore on the pan conveyor is reduced to a certain predetermined depth. This provision is made to protect the surface of the pan conveyor from impact of the large pieces of ore falling from the cars above. The finger gate consists of seven cast-steel arms, provided with adjustable weights and pivoted on a 9-in. steel shaft, so that they may lift to permit the passage of exceptionally large pieces of ore. The pivot shaft is supported on a framework adjustable for height, so that the depth of the ore bed on the pan conveyor can be varied to conform to the requirements of the crushing plant. The counterweight arms of the finger bars are in an approximately horizontal position and are supported by a heavy steel beam, which is a part of the framework mentioned, so that the wearing teeth of the finger bars are always brought to a common line. The liners and protection devices of the concrete hopper are especially rugged, to provide against the shock and wearing action of the ore, which is particularly severe. The ore is massive and blocky, and in some cases pieces as large as 4x4 ft. in section and 8 or 9 ft. long have been successfully handled through this gate.

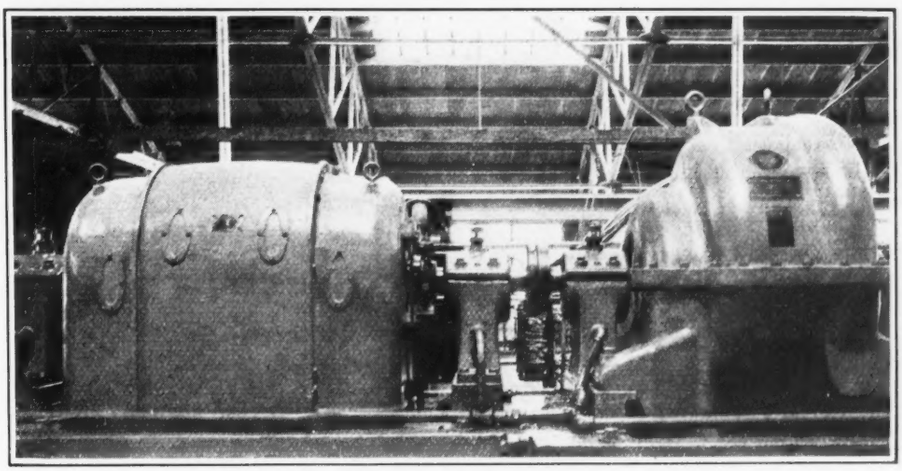
The pan conveyor, built at a slope of about 20 deg., is approximately 74 ft. long, center to center of head and tail shafts. The carrying surface is made of 1x12-in. steel plates riveted to steel links 8 in. wide, spaced so that the links of adjacent bottom pieces engage a connecting pin 2½ in. diameter, the links being staggered across the full width of the conveyor. The load is carried on rollers mounted on stationary bearings on a substantial steel frame, the bearings being lubricated by an ample reservoir of lubricant and being accessible for inspection and lubrication. This is a marked improvement over the ordinary type of pan conveyor in which the rollers are attached and move with the pan, making them difficult of access. Power is applied to the conveyor from a solid hexagonal forged shaft through a train of gears. Heavily framed steel skirt boards are protected with 2½ in. cast-iron liners and stand about 6 ft. high. These are set at an angle, so that the ore channel is approximately 10 ft. wide at the top. The pan conveyor is driven by a 75-hp. variable-speed motor at a nominal operating speed of 10 ft. per minute; and, with the finger gate set at 3½ ft. above the top of the conveyor, provides feed to the crusher at the rate of about 750 tons per hour, easily handled by a crusher of this size; and, although the crusher may look unusually large for the rate of feed proposed, its size and capacity was determined more by the maximum size of the rock handled by the steam shovels than by the available crushing rate. This is a point sometimes overlooked in academic discussions of crushing plants and material-handling systems.

The necessity of screening a crusher feed has long been recognized, but the application of the idea has not always been successful. The revolving-ring grizzly used in the Ajo plant consists of a series of rings of two sizes, the smaller ones being fixed to a supporting cage revolved by a belt drive from the conveyor or other source of power; the larger rings, spaced alternately between the fixed rings, are not rigidly attached to the frame. The ore is fed to the upper surface of the grizzly, and the screening arrangement between the tight and the loose rings allows the undersize to separate from the coarser material, which is carried forward and delivered by the revolving motion of the grizzly. The loose rings, being of a larger diameter, provide an increased space for the escape of the undersize material from the inside of the grizzly. The screening action is positive, and the grizzly is self-cleaning to an extent not heretofore attained. The work of these grizzlies will be watched with interest, and their application should prove a decided step forward in coarse screening.

Motor-driven Rolls Selected for Final Crushing

A highly important question in concentrator practice —one that has not been definitely answered and cannot be answered specifically except for each ore and plant under discussion—refers to the size to which the grinding-mill feed should be reduced in the dry-crushing plant. This is a question that must be decided for each individual instance, the general rule being that the harder the ore the finer it should be crushed before feeding to the grinding mills; but the limit can be determined only by experimental work under operating conditions. In a certain plant that I remodeled in recent years a marked increase in efficiency was gained by increasing the size of the grinding-mill feed, at the same time making a radical change in the machines used for dry crushing and wet grinding. In selecting the machines for the New Cornelia plant it was realized that no real data were available on which to base a definite conclusion. The crushing-plant equipment was therefore chosen with the object of having a flexible arrangement that could be adjusted to the production of a mill feed of a size to be determined later. In selecting rolls for the final dry crushing, following in turn the horizontal disk crusher and the No. 8 gyratories, it is believed that the utmost flexibility has been attained.

The rolls are operated in closed circuit, with ample screening capacity for removing ore as crushed, a prominent feature being the method of drive, accomplished by two slip-ring motors instead of the usual arrangement of driving from a countershaft. The motors are provided with speed control, so that the peripheral speed of the roll shells may be kept approximately constant, even though one of the shells is worn to a much smaller diameter than the other. Each of the rolls has an overhung pulley, belted to the motor, a belt tightener being provided for each drive. The motors are equipped with unusually long sliding bases, to compensate for belt stretch and movement of the roll



This two-stage blower, with a capacity of 20,000 cu.ft. per minute, furnishes air for the flotation machines

shaft due to wear of the shells; and the motor control, by means of a full automatic starter, is arranged so that both starters are controlled by one push button. The rolls are designed for a spring pressure of fifteen tons per inch of width of face, and they have tension rods above and below the center line of the shafts, to equalize pressure on the bearings. The cheek plates can be adjusted while the rolls are in operation, and are arranged to be revolved about the center so that they may be worn out with a minimum of waste.

Lubrication is insured by a continuous gravity-pressure oiling system, which serves the entire fine-crushing plant and consists of filters of the open-bag type and motor-driven oil pumps taking the oil from the clean-oil compartment of the filter and delivering it to a storage tank in the roof trusses of the building. Sight-feed oilers are provided for observation and regulation of the oil steam, to each bearing, and it is believed that the application of this system of lubrication to disk crushers and rolls will prove highly satisfactory. The roll bearings have ample water cooling jackets, and it is felt that no difficulty will be maintained in keeping temperatures well within the safe limit.

To prevent serious trouble from the stopping of any one of the crushing or conveyor units while those bringing material to it are still operating, this equipment is on an electric interlock that insures the operation of any given unit before feed can be brought to it by the unit preceding. Thus, before any crushing or conveying unit in the fine-crushing plant can be started, the conveyor system to the concentrator bin must be in operation, and this interlock is continued back to and including the feeders under the intermediate storage bin. Provision is made, however, that the stopping of any conveyor will not stop the crushing element feeding it, although it will stop the conveyor or feeder to that crushing unit. This provision is made to avoid the necessity of starting the rolls, disk crusher, or gyratory when full of ore, which might easily happen if it was directly connected into the interlock. Stopping of the rolls or of the disk crusher or gyratory will, however, stop the conveyors delivering ore to them. A similar interlock is installed for the coarse crusher and its conveyor system, although this system is not tied into the intermediate and subsequent operation, the intermediate storage bin making this unnecessary.

Another feature of the New Cornelia installation is the use of a semi-gantry crane in the concentrator for handling the primary and secondary mills and accessories. This has resulted in a considerable reduction in the amount of steel required for the building, a saving, of course, that would be increased should the building be extended. The crane girder at the higher level is supported on the bin columns, which are, necessarily, of heavy section, to carry the bin load; and the lower crane rail is built into the floor on top of the wall, forming one side of the electric-cable conduit. This craneway extends the length of the mill and 60 ft. into the shop building immediately at the west end of the main building. Thus, heavy materials coming into the concentrator can be handled directly from railroad cars on the shop floor to the operating floor by the main crane without transfer. Operating at the same level and with one truck on the upper rail provided for the semi-gantry, a higher-speed, 5-ton crane of standard type is provided for handling rods and lighter materials. The gantry crane is able to handle a rod mill, completely equipped with rods and liners, so that a spare mill can be assembled and maintained ready for service on the assembly floor, and put into operation with the minimum of delay. The gantry leg is equipped with a 20-ton boom, with chain block for handling the flotation blowers or other material outside the reach of the crane trolley.

In the concentrator a gravity-oiling system is provided for the roller mills, similar to that in the fine-crushing plant. Each of the roller-mill bearings has two sight-feed oilers, and a constant supply of fresh clean oil assures uninterrupted operation. The oil, conducted to filters in the cable tunnel at the east end of the mill, is pumped after filtering to a storage tank in the roof trusses above the craneway. This storage tank, with a capacity of about 1,000 gal., is 3 ft. diameter and 22 ft. long, supported in a horizontal position. It is divided into two compartments by an oil-tight partition extending to within 4 in. of the top. Oil is pumped into one end of the tank, and as soon as this compartment is filled it overflows into the other compartment, which serves as a supply for ordinary conditions. The first compartment, remaining full of oil, is held as a reserve if the return should be interrupted. This reserve supply, utilized by opening a valve at the operating floor, will furnish sufficient oil to enable temporary adjustments to be made without closing down the mills. Indicating gages and meters keep the operator informed as to the supply and flow of oil. Similar oiling systems are provided for the primary crusher and also for the four gyratory crushers at the intermediate crushing plant.

Each flotation blower unit is equipped with its own self-contained oiling system, and at the time the plant was put into operation in January, 1924, the oil temperatures remained steadily at 162 deg. F. This temperature is not dangerous, but it was felt that during the summer months it might rise to an undesirable level, and it was considered advisable to provide a cooling coil. Accordingly, one was made at the local shop, of about 250 ft. of ¾-in. copper tubing on hand at the warehouse, and this was introduced into the oil circuit in the tunnel immediately below the blower. This insured a constant flow of air for cooling the oil, the temperature of which since installing the coil has been reduced to 135 deg. F.

In the design of the buildings the appearance of the finished structure was considered as well as utility, accessibility, and ease of handling the equipment. The result is that in symmetry and arrangement the concentrating plant of the New Cornelia Copper Co. is unexcelled. Ample provision was made for light, both by day and at night. The windows and skylights are of ample proportions. Ribbed glass provides a uniform distribution of daylight and eliminates glare.

Ample ventilation is provided by means of ventilating sashes, louvers, and, in some cases, open ventilating spaces at the roof line of the buildings; and it is felt that the temperature within the buildings will be considerably lower than that of the outside air. The features of accessibility and ease of handling the equipment are also emphasized and amplified by the arrangement of runways and operating platforms that assure the operators a free and unobstructed view of the equipment under their charge. This feature is especially emphasized in the arrangement of the concentrator, whereby the flotation machines and classifiers

are supported on a balcony immediately above the tables. This enables the operator to observe not only the performance of flotation and classifying machines but also the tables; it results in a reduction of operating personnel with a minimum of effort on the part of the operator. This idea is also carried out in the arrangement of the primary and secondary mills and classifiers, which provides for a continuous runway the entire length of the mill, from which the mill operator can observe both the primary and secondary equipment.

Particular attention was given to steel and concrete details, as to design and fabrication, with a resulting economy of construction costs and pleasing finished appearance. One feature that deserves particular mention is the design and method of fabricating the concrete table and flotation boxes. These were detailed in such a way that they could be cast in removable forms in a casting yard and later handled into position as required. Pre-cast concrete stair treads were also employed with marked economy over either steel or cast-iron treads, and the idea was carried still further in pre-casting floor slabs for the conveyor housings. This resulted in considerable economy over the ordinary procedure of building concrete floor slabs in conveyor housings, which are of necessity a considerable height above the ground and not easily accessible.

Equipment in the New Cornelia Concentrating Mill, at Ajo, Ariz., and Accessory Operations

Equipment	Trade Name or Type	Manufacturer and Address
Steam shovels	Osgood Model 105	Osgood Co., Marion, Ohio
Standard-gage ore cars	20-yd. automatic air side-dump cars.	Case Crane & Engineering Co., Kilbourne & Jacobs Division, Columbus, Ohio
Pan conveyors		Worthington Pump & Machinery Corporation, Cudahy, Wis., and Stephens Adamson Manufacturing Co., Aurora, Ill.
Gyratory crushers	McCully	Worthington Pump & Machinery Corporation, Cudahy, Wis.
	Gates Style K	Allis-Chalmers Manufacturing Co., Milwaukee
Motors and electrical equipment		Westinghouse Electric & Manufacturing Co., Pittsburgh
Conveyors	Ball-bearing	Stephens-Adamson Manufacturing Co., Aurora, Ill.
Disk crushers	Symons horizontal	Chalmers & Williams, Chicago Heights, Ill.
Rolls		Traylor Engineering & Manufacturing Co., Allentown, Pa.
Ring grizzlies	Burch	Stephens-Adamson Manufacturing Co., Aurora, Ill.
Weightometers		Merrick Scale Manufacturing Co. Passaic, N. J.
Rod mills	Marcy	Queen City Foundry Co., Denver, Colo.
Classifiers	Dorr	The Dorr Co., Denver, Colo.
Tables	Plat-O	Deister Machine Co., Fort Wayne, Ind.
Thickeners	Dorr	The Dorr Co., Denver, Colo.
Vacuum filters	Drum	Oliver Continuous Filter Co., San Francisco, Calif.
Vacuum pumps		Ingersoll-Rand Co., El Paso, Tex.
Compressors		Ingersoll-Rand Co., El Paso, Tex.
Blowers	Turbo	De Laval Steam Turbine Co., Trenton, N. J.
Magnetic clutches		Cutler-Hammer Manufacturing Co., Milwaukee
Centrifugal pumps		De Laval Steam Turbine Co., Trenton, N. J.
Wood stave pipe		Pacific Tank & Pipe Co., Los Angeles
Plunger pumps		Worthington Pump & Machinery Corporation, Cudahy, Wis.
Dayton couplings		Youngstown Sheet & Tube Co., Youngstown, Ohio
V-notch meter	4,000 g.p.m. Yarway-Lea	Yarnall-Waring Co., Philadelphia
Cranes		Pawling & Harnischfeger Co., Milwaukee
Conveyor belts		Goodyear Tire & Rubber Co., Akron, Ohio
		Goodrich Rubber Co., Akron, Ohio
		New York Belting & Packing Co., New York
		Manhattan Rubber Manufacturing Co., Passaic, N. J.
		Robins Conveying Belt Co., New York
Oil filters		S. F. Bowser & Co., Fort Wayne, Ind.
Structural steel and iron		Wisconsin Bridge & Iron Co., North Milwaukee, Wis.
Sand pumps	Wilfley	A. R. Wilfley & Sons. Denver

Arsenic Deposits Near Seattle, Washington

Several Old Well-developed Gold-Silver Mines Now More Attractive Owing to Higher Prices for Byproduct

By P. C. Stoess
Mining Engineer, Seattle, Washington

THE growing importance of arsenic and its compounds has renewed interest in the mining districts of Snohomish and King counties, in the State of Washington. The region, which is among the oldest arsenic-producing areas in the United States, has probably produced more arsenic than any other district in the country. It includes the deposits of the Goat Lake, Monte Cristo, Miller River, and Money Creek areas. Arsenic was first discovered there in 1889. Although it was known at that time that the ores of these deposits carried arsenic in unusually pure form in commercial amounts, there was no production of arsenic, and all the arsenic compounds used were imported. The deposits accordingly were opened and worked for their gold and silver content only.

The district is about 2 miles wide and 25 miles long, extending from Goat Lake Basin and the North Fork of the Sauk River in a southerly direction to Miller River and Money Creek basins. At Silverton, about 12 miles west of Monte Cristo, there is another small area where ores of practically identical nature have been found and partly developed.

Veins Vary Greatly in Width

The formation generally consists of granites overlain by more or less altered slates, schists, and sedimentaries, accompanied by intrusive dikes, all sheared in many places and highly mineralized. Aside from copper deposits of promise occurring in an entirely separate and distinct series of veins, this district contains many fissures penetrating both the granites and altered sedimentaries. These veins vary in width from a few inches to more than 15 ft. The ore appears to occur in more or less irregular shoots from 25 to as much as 300 ft. in length. These veins, where they have been developed and worked with any attempt at system, show persistence not only vertically but laterally.

The ores consist for the most part of arsenical pyrite, sometimes associated with cubic iron pyrite and a little pyrrhotite; also some galena and occasionally, as impurity only, a little zinc blende. In a few of the veins antimony is found associated with the arsenical pyrite in the form of what is known locally as "black ore," an arseno-antimonial sulphide, which, like the other ores of the country, carries gold and silver in commercial amounts. These minerals occur in a quartz gangue associated with some felsite, occasionally a little lime, and some more or less altered country rock.

Early Operations Took High-Grade

The content of ores in different veins varies, and in many cases exact records are not available. Generally, the veins carry shoots of higher-grade ores associated with much larger bodies of low-grade or milling material. Early operations were confined to higher-grade ores, the development of extent of lower-grade stuff not having been attempted.

Based on samplings of several of the mines and prospects, and on the record of ore shipments available, the values in the ores worked up to the present would range from $6 to $20 per ton in gold and silver. One of the mines, however, has shipped many cars of partly hand-picked ore which average $50 per ton.

The arsenic content runs from 4 per cent to as high as 30 per cent in the clean ores and probably averages around 10 per cent to 12 per cent throughout the district, as nearly as may be estimated. It is noteworthy that the values are generally maintained from the highest workings in the mines of this district to the lowest points opened.

The few samplings attempted in the lower-grade orebodies indicate large amounts of ore carrying from $2 to $4 per ton in gold and silver, with arsenic estimated at from 2 per cent to 5 per cent.

The mineral can be readily separated from the gangue by ordinary concentration methods. In former operations with water concentration only and a plant which was not of high efficiency, a recovery of from 55 to 65 per cent was effected. In some recent tests with water concentration followed by flotation a recovery of more than 90 per cent was indicated.

In a few other veins galena and tetrahedrite have been found, and in one property, ruby silver; these minerals have generally run the silver values up far beyond the average content. Small shipments have been made carrying as high as $250 per ton in gold and silver, in hand-sorted ores. The possibility of the occurrence of other arsenical sulphide ores with the arsenopyrite has not as yet been determined. Occasionally realgar, orpiment, and white arsenic are found in the mine workings, usually occurring as a thin film covering the sulphide.

Little Work Done in Recent Years

Exact records of the operation, development, and tonnage mined are not available. During most of the period of active operations, twenty-five to thirty years ago, it was not customary to make the careful record of such work as is now considered desirable. However, from facts available, from knowledge of the extent of old stopes and workings, I think it probable that not less than 400,000 tons of ore has been mined in this district, most of which has come from the old Monte Cristo section.

Careful inspection of the lowest of the old workings at present time will show that ore similar to that worked above has been left in the floors.

A large amount of development has been done in the district, some of which has been on property which is from 2 to 8 miles from transportation. Lack of capital to complete operations and provide transportation facilities has prevented such properties from shipping.

Extensive Development in Old Mines

One, the Penn Mine, in the north end of the district, has more than 2 miles of underground development, opening one of the several known orebodies to depths of 1,000 to 1,500 ft. below the croppings.

In the old properties at Monte Cristo there are probably not less than 5 miles of underground workings through which ore has been extracted to gross depths of over 2,500 ft. below the higher croppings and to depths in the individual mines of from 600 to 800 ft. below the surface.

The topography of the country, consisting of high, precipitous mountains rising abruptly from deep-cut valleys, provides conditions for cheap operation and development. Tunnel sites to depths of over 2,500 ft. are available in many cases. Ample water power and fine timber are at hand.

Situated Near Tidewater, Timber, and Supply of Labor

The district is traversed not only by the main line of the Great Northern Ry., but also by the Hartford & Eastern branch of the Northern Pacific, which runs into Monte Cristo, within a few hundred feet of several of the mine workings. In most cases the excellent timber in the valleys will offer inducements for transport facilities which will eventually bring all the mines in close touch with the lines already established. The development and increasing use of caterpillar tractors for haulage under conditions existing in the district also removes much of the transport difficulties which, up to recently, have been an obstacle to mine development.

The commercially strategic position of the deposits of this district cannot be overlooked. Within 55 to 60 miles of deep tidewater and world ports, with large centers of supply and labor, such as Seattle, within less than 75 miles, many problems incident to mining operation are made easier.

It must be remembered also that to date the efforts in handling the ores of the camp have been confined to recovering the gold and silver only, and that the mines, up to very recent times, have not received credit for the arsenic contained in the ores.

The bulk of the arsenic-gold-silver ores of this district, sold either as crude ore or concentrate, went to the old plant of the Puget Sound Reduction Co. at Everett, where the first arsenic-recovery plant in the United States was erected in 1899 and operated there until it was bought by the American Smelting & Refining interests, which several years later dismantled the Everett arsenic plant and rebuilt it, at the plant of the Tacoma Smelting Co., which they also owned. This pioneer arsenic plant at Everett treated most of the ore from Monte Cristo up to the time of its being dismantled, and marketed the white arsenic product at the then prevailing prices, 2¾ to 4c. per pound. The white arsenic made at this plant rapidly gained a reputation for its purity and uniformity. The mines, however, were not given credit for arsenic content until many years later, when the Tacoma Smelting Co. made tentative agreements, based on marketing the product, to pay the mines on 80 per cent of the assay content of metallic arsenic. They deduct 5c. per pound from the market price and then pay to the mine 50 per cent of the balance on the 80 per cent content basis. At the present time this arrangement is still in effect and offers the only market for arsenical ores available for this district.

Taking into consideration the extent of deposits, and the high arsenic content (and the accompanying gold-silver content, which should, in many cases, with proper equipment, pay for operation on moderate scale without considering the arsenic values at all), the commercially strategic position of the deposits close to salt-water transport, and the industrial activity and markets, those who know this district feel that it offers an opportunity to develop a substantial and important arsenic-mining industry.

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

"Exploring the Earth's Crust"

THE EDITOR:

Sir—The subject-matter of your editorial under the above heading in your issue of Oct. 11 has long interested me. Discoveries of perhaps vast importance commercially as well as from a purely scientific standpoint await the sinking of a rightly situated super-deep exploration shaft—discoveries which, either directly or indirectly, might really benefit humanity.

The cost, too—as costs go, these days—would not be appalling. I have long wondered why such a venture has not been undertaken. Other things being equal, the sinking of such a shaft would be of more benefit in a notably mineralized area of the older rocks than elsewhere.

Why is it that in your country and mine we are now spending vast sums on endowed homes for stray dogs and cats (whose proper and merciful destination is the lethal chamber) and yet doing so little in many useful and good works which would benefit millions?

I am an Englishman born, who grew up in California and was the very staunchest of believers for many years in your country and mine. I believe no longer in either of them—in their collective sense of justice and sanity—for the ceaseless logic of events makes belief impossible to those who think. I need not cite what is going on under your flag, though (as all good Americans respect Oliver Cromwell) I would like to quote these words of his in a letter to the Governor of Edinburgh Castle, dated Sept. 12, 1650:

"Your pretended fear lest error should step in is like the man who would keep all wine out of the country, lest men should be drunk. It will be found an unjust and unwise jealousy to deprive a man of his natural liberty upon a supposition that he may abuse it. When he doth abuse it, judge."

This seems far from mining, but here is something in my own country, perhaps more apt:

Upon the great "slump" late in 1920 and early in 1921, no less than three "deputations" went from Cornwall to London to beg the government for a loan (a loan, mark you—not a subsidy) of a paltry £200,000—say $900,000—to keep the deep tin mines going till the tin market revived. They pointed out in the most forceful way that thousands of men would, if the loan be refused, be out of work and that double the money would be required in Poor Law relief to keep these people and their dependents—money *given away*, to keep them in idleness. The government resolutely refused to grant a loan, the mines stopped, and in the three years till the revival set in more than £500,000 was given in charity to deliberately pauperize these men, when less than half the money—*and as a loan to be repaid*—would have kept them at work.

Liskeard, Cornwall, England. A. SPENCER CRAGOE.

"Smelting Copper Concentrate in a Converter"

THE EDITOR:

Sir—Your editorial of Oct. 25, 1924, "Smelting Copper Concentrate in a Converter," recalls an interesting plant erected at Garfield, Utah, and operated in an experimental way for a few weeks in 1908 and 1909. The plant, which had a daily capacity of 100 tons, was designed by Edward Fink, and operated on the concentrates of the Boston Consolidated mill, near which it was built. For the benefit of those who have forgotten, or whose memory does not run that far back, I will recall that the Boston Consolidated operated a part of the great "porphyry" deposit at Bingham adjoining the Utah Copper Co., by which company it was absorbed in 1910.

The 100-ton smelting unit consisted of two 9x9-ft. steel drums, each similar in shape to a Leghorn converter without a throat and similarly mounted. These drums were set end to end and connected by a flue, so that the gases of combustion would pass from one through the other. Each was connected to a stack, so that the draft could be reversed. By this means one drum was brought to an intense heat and the gases passed from it to the second, where they gave the charge a preliminary treatment before discharging to the stack. When the charge in the first drum was poured it was recharged and the draft was reversed, and this charge then received an initial and preliminary treatment while the operation was being completed in the second.

Air was introduced under pressure through a pipe terminating below the level of the charge. The fuel, either oil or pulverized coal, was blown in, only one drum at a time receiving fuel. The drums were revolved slowly in opposite directions, so that the air would be brought into contact with all parts of the charge. I do not recall now whether tapping was through three orifices at different levels or through one orifice by revolving the drum so as to tap successively the three products—blister, matte, and slag.

The smelter produced blister copper of a high grade, and it was thought at one time that it would win a place in the mining industry, especially in making it possible for small mines to produce their own copper. It failed because the designer was unable to give it a lining that would withstand the terrific heat necessary to matte and bessemerize copper in one process. This might have been worked out, but the inventor and his financial backer, Samuel Newhouse, had a falling out, and the work was discontinued. It is interesting to speculate as to what these experiments might have led to had basic linings for converters been as well known and understood at that time as they are at present. It was not until several years later that basic linings came into common use.

A brief description of this process appeared in the *Mining Journal* (London) of Feb. 20, 1909.

San Francisco. LEROY A. PALMER.

Prospecting "Wrinkles"

THE EDITOR:

Sir—When a man is prospecting in central Idaho, or British Columbia, hundreds of miles from the nearest assay office, the following prospecting "Wrinkles" come handy; many prospectors know them and engineers of course, also, but many who want to prospect, do not know them. This is how I examine samples: I have a mortar and pestle. The mortar is the bottom end of a iron quicksilver tank three inches high. It is light and unbreakable. The pestle is a broken wagon king bolt six inches long, rescued from the blacksmith's scrap heap. With these I can powder any honeycomb quartz for free gold. Often no free gold is found, but a quantity of iron pyrites, often auriferous; but the barren pyrites looks exactly the same as do materials which carry values. To find out whether the pyrites carries gold or not, I rustle an old shovel, or frying pan, smear it with clay and dry it, and after I have cooked and eaten supper, pile a lot of wood on the camp fire and let it burn down to a good bed of live coals. I then powder the sample and add about an ounce or more of nitre, of which I carry about a pound in the pack, and mix it well with the sample and put it on the shovel, and then place the shovel on the bed of coals to roast. I keep it red hot, smoke my pipe, stir it with green willow from time to time for several hours, until I stretch out in my blankets. Over night the whole thing will have cooled down. I put it aside until after breakfast, then knock the more or less sintered mass into a gold pan—burnt clay and all—transfer it to the mortar again, rub it up well once more, and then pan it in the water as with other free ore. If any unroasted pyrites shows, the job has been poorly done, but even then some yellow gold will often show if the pyrites is rich.

There are wrinkles for silver ore, but to describe them would make this letter too long.

Silver Lake, Mont. WILLIAM H. BAUR.

"The Socialistic Trend"

THE EDITOR:

Sir—Your editorial on "The Socialistic Trend" is to the point, and now, since it is so obvious that engineers outside of Colorado take exception to it, I will state my experience in competing with the Colorado School of Mines test plant and the professors or directors in charge who are acting as consulting engineers when and wherever they can get a client. I therefore would like to state my case and ask a few questions which I hope will be answered through your columns:

Four months ago I was in direct competition with Mr. Weinig, director of the Colorado School of Mines test plant, to see if I could get the designing of a mill and the contract for furnishing the machinery for same. He had been recommended by an engineer friend to do this work. He ran tests at the Colorado School of Mines test plant on this ore, submitted reports and hired draftsmen to draw up flow sheets for this mining company, in the Colorado School of Mines test plant drafting room, and was in the middle of laying out the drawings for the big mill before I was able to convince the people connected with the mining company that I could lay out their flow sheet and design their mill better than he could with all the facilities he had of the Colorado owned test plant.

I also understand that Mr. Weinig is retained as consulting engineer by the Stearns-Roger Manufacturing Co., which builds mining and milling machinery. I would like to know positively if this is correct. If it is, I think it would appear that his judgment, when confined to ore testing, designing mills and recommending machinery, would be biased by this connection.

When the people connected with this mining company decided to adopt my flow sheet and install my machinery, they asked Mr. Weinig to discontinue his work and send in his bill. In the course of time, the bill, amounting to nearly one thousand dollars, was paid.

Now, I am a taxpayer in the State of Colorado, and therefore a contributor to the support of the Colorado School of Mines test plant, of which Mr. Weinig is a director. He is therefore indirectly working for, and being paid by, me. I am also a manufacturer of mining and concentrating machinery, designing mills, drawing flow sheets, and I charge for my services and machinery to pay office rent, insurance, traveling expenses, sales expense, and out of what is left I take my living. Therefore, I want to know:

1. What part of that approximately $1,000 went to the state for the use of the test plant, grinding equipment, flotation machines, power, rent, insurance, depreciation?

2. Who did the assaying, and how much were they paid?

3. How much was the state paid for the use of the drafting room, lights, and equipment?

4. A draftsman was employed on this job in the test plant drafting room; how much was he paid?

5. How much was kept by Mr. Weinig personally for his services?

There is now being maintained an assay office in the test plant and an assayer working by the month. It certainly must be very fine to be able to go out on consulting trips, send in the samples, test and assay them in a test plant maintained by the state, giving your client the benefit of the assaying at cost, which, I understand, is 60c. per determination. It is also possible for these test plant professors to advise their clients that their fees will not be so great as those of an outside engineer, since in addition to their consulting fees, they receive a salary from the state. How much consulting work they can handle before it interferes with their teaching I do not know; but my supposition is that they will take in consulting work until the teaching interferes with it, and then they will stop the teaching.

In looking over the last report, published in the *Rocky Mountain News*, on their activities, the following appears under the headline "Ore Tests Are Completed at School of Mines":

> "In the past month at the School of Mines metallurgical plant, tests and reports have been completed on: a Montana gold ore, a Nevada mill tailing, two copper refinery sludges, a European molybdenum ore, a Mexican cyanide ore and a Lake City gold-silver ore. Tests in progress, but not completed, are a molybdenum refinery sludge, a diamond concentration problem from South Africa, a Colorado tungsten ore, and a Colorado oxidized lead-silver ore.
>
> "Two trips of inspection and consultation were made by Director Weinig. Professor Warren made one trip with a prospector to Mount Harvard to look over the possibilities of some prospects that had been uncovered in a new region.
>
> "Continued work on the reasons for differential flotation has been carried on as well as some grinding resistance experiments in the minus 200 mesh field."

As a suggestion to the Board of Trustees, they might

look around and see if it is not possible to find some capable engineers who will teach and direct the test plant for the privilege of making whatever they can out of the assaying and consulting work which they might get in connection therewith. As I understand it, in New York waiters pay huge sums for the privilege of working in the restaurants of some of the exclusive hotels, just for the tips they receive.

The *Engineering and Mining Journal-Press* editorial quotes from President Coolidge as follows:

"If the people can run the government they can likewise conduct business—direct—and not through the instrumentality of the government which they have set up for political, not business, purposes."

In our particular case this could very aptly be changed to:

"If the people can run the State of Colorado they can likewise conduct business—direct—and not through the instrumentality of the test plant which they have set up for educational, not business, purposes."

I would like to hear, through the columns of your publication, what these trustees, directors and professors of the test plant have to say to substantiate their position. JOSEPH P. RUTH, JR.

Denver, Colo.

THE EDITOR:

Sir—In an editorial in your issue of Oct. 11 you have stigmatized the valuable and useful work which is being done at the Experimental Plant at the Colorado School of Mines as "socialistic" and have expressed the opinion that "consulting engineers will view these state-subsidized widespread consulting metallurgical activities with surprise and consternation." We, the undersigned consulting engineers of Denver, who are all in more or less close touch with the work in question, wish to make public the fact that our attitude toward it is one of hearty approval and not in the least that which you have surmised.

You have assumed, altogether erroneously, because certain tests, mentioned in the newspaper article you quote, were made *at* the School of Mines, that they were made *by* the state, whereas most of them were made under the direction and at the expense of private companies or individuals.

You also seem to assume that the plant was built to enable the state to make ore tests in competition with private concerns. This is not the case. It is primarily a laboratory in which the students receive the necessary instruction in ore dressing and metallurgy and where research work in these subjects can be and is prosecuted. Secondarily, it furnishes means for mine owners and engineers to work out their own particular metallurgical problems, being available for the use of any responsible person upon the payment of a nominal fee.

You speak as if the working out of metallurgical problems by and at public institutions were something new and startling, whereas such work has been carried out by the U. S. Bureau of Mines and various state mining schools for many years with considerable commendatory comment from the profession and, if we mistake not, from the *Engineering and Mining Journal-Press*.

We believe that the facilities offered for making metallurgical tests at Golden tend to increase the business of the individual engineer rather than otherwise. The work done there is, for the most part, not such as could be done by the average mining company or individual engineer, because they cannot afford to equip testing plants for the purpose and there are very few, if any, private testing plants as completely equipped as that at our School of Mines. The fact that an engineer knows that he can make ore tests in an adequately equipped laboratory with the aid and advice of its expert directors leads him to encourage his clients to investigate many mines which, under less favorable circumstances, would involve a prohibitive expense. This encourages mining in general and makes more business for the mining and metallurgical engineers.

D. W. BRUNTON
STUART CROASDALE
E. W. KEITH
CHARLES N. BELL
RICHARD A. PARKER
CHARLES A. CHASE
ROBERT H. SAYRE
HORACE F. LUNT
GEORGE J. BANCROFT
O. R. WHITAKER
EDWIN E. CHASE & SON
(R. L. CHASE)

Denver, Colo.

THE EDITOR:

Sir—Formerly there were several well-equipped ore-testing plants at Denver. For lack of business these are now not in operation, and the State School plant supplies the need. No other place could afford to maintain an establishment of sufficient size and equipment for ore tests of any considerable size. Therefore, whatever some of us may think of the condition and conduct of the Colorado School of Mines in some other particulars, we must, as practicing engineers, regard the ore-testing plant as of advantage. VICTOR G. HILLS.

Denver, Colo.

An Error Corrected

THE EDITOR:

Sir—In your issue of Sept. 13, 1924, you give more than ordinary prominence to an item appearing on page 428 under the caption, "Bureau Engineers Recommend Government Reduction Plant in Alaska." That you considered the matter you reported in this item of special importance is indicated by your italicized statement in your "Summary" that "A recommendation by Bureau of Mines engineers for the erection of a government-owned reduction plant at Anchorage, Alaska, seems to establish a new precedent." Inasmuch as the recommendation you report has never been made, the matter contained in your "news" item is entirely erroneous, and your comment as to a new precedent being established is, therefore, without basis in fact.

I presume in this case the misinformation that you printed as fact came to you through the ordinary press channels, although the article itself does not indicate it. No such report as you printed was given to any press representative or other person in Alaska, by my office, which is the only agency in the territory authorized to make recommendations as to matters affecting the policies of the Bureau of Mines in Alaska. You will no doubt appreciate the harm done by broadcasting misinformation regarding official action and policies. It is, therefore, requested that you publish a statement calling attention to the error in the report printed by you, giving it prominence equal to that given the erroneous report. B. D. STEWART,

Supervising Mining Engineer for Alaska.

Washington, D. C.

News of the Week

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Summary

CONSUMMATION of a merger of the Inspiration and Ray Consolidated companies—including Chino, of course—seems to depend on reaching an agreement as to terms. Such an agreement seems likely, though it may take some time.

The Tonopah Mining Co. has disposed of its Ajax property at Victor, Colo., to the Granite Gold Mining Co., which is expected to continue operations.

Sinking its No. 2 shaft 500 ft. will be undertaken in about sixty days by the California-Rand Silver, Inc. Mill operations then will be discontinued temporarily.

Calumet & Hecla's Ahmeek mine is now operating at 75 per cent capacity, running six of the eight stamp heads in the mill.

Net profits totaling $609,000 were realized in the year ending Aug. 31 by the Teck-Hughes Gold Mines Co. at Kirkland Lake, Ont. Recovery averaged $26.97.

In the Cascade district of the Marquette iron mining range, in Michigan, two low-grade mines are running at capacity and two others probably will start. The ore is siliceous.

Domestic magnesite producers protest against what they consider unwarrantable delay in consideration of their case by the U. S. Tariff Commission.

It is authoritatively reported that the Comstock Merger Mines Co., controlled by British interests, has acquired the mines and mill of the United Comstock Mines Co., belonging to the Metals Exploration Co.

Mines in the Cascade District, Michigan, Find Market

Low-Grade Siliceous Iron Ore in Good Demand—Cleveland Cliffs and Hanna Expand

The Cascade district of the Marquette iron-ore range, in Michigan, has been active for some time, due to the demand for low-grade siliceous ores. Such ores are desired by furnacemen for the "mix" and are put into the furnaces with ores of higher grades. The two pit mines, the Richmond, of the M. A. Hanna Co., and the Maitland, of the Maitland Mining Co., have been active shippers all season and are still forwarding to the Lake docks. Virtually all independent shippers of other grades of ore are through.

It is certain that there will be another pit, and possibly two in the Cascade district in 1925. At the present time the Cleveland-Cliffs Iron Co. has two diamond drills at work on lands which they own, and siliceous ores will probably be found. One of the largest independent producers in the Lake region is now negotiating with the owners of another group of lands, and it is known that this company desires siliceous ores. The M. A. Hanna Co. is planning on the erection of a large crusher to crush the product from the Richmond, and new ground to be mined is to be opened up on lands recently procured, at some distance from the Richmond. There is one underground mine on the Cascade which is producing ores of higher grade. This is the Isabella, operated by Pickands, Mather & Co. Where many iron-ore districts had difficulty this year in disposing of their product, the Cascade mines operated to capacity, because of the demand for low-grade ores carrying high silica.

Trail Ore Shipments Up

TRAIL, B. C., smelter receipts for 1924 to the end of October totaled 388,733 tons, which is 49,911 tons more than was received in the same period of last year. The increase in metal content of the material will be even greater, as a larger proportion has been received in the form of concentrate.

Tonopah Mining Co. Abandons Ajax Property at Cripple Creek

The Tonopah Mining Co., of Nevada, has sold the Ajax property, at Cripple Creek, Colo., which it acquired two years ago and on which it has been working since. The company developed and mined a considerable tonnage of ore, but apparently cannot see the prospect of continued profitable operations. It is believed that the Granite Gold Mining Co., which has taken control of the Ajax ground, will continue work. The main shaft may be sunk deeper in the hope of cutting further oreshoots. The Granite company owns the adjoining claims and believes that it can work the combined properties to better advantage. The Tonopah Mining Co. will continue to operate its Breckenridge placer properties in Colorado.

United Verde Extension Tax Tender Refused by County

Officials See Move To Get Acceptance on Smaller Levy—Last Year's Suit Dismissed by Company

A check, tendered in payment of the first installment of the 1924 taxes, by officials of the United Verde Extension Mining Co. has been refused acceptance by the County Treasurer of Yavapai County, on the grounds that it represented one-half of an amount that was between $60,000 and $65,000 less than that due under the tax levied against the property of the mining company by the county assessor.

It is reported that state tax officials believe that mine officials had deducted about $2,000,000 from the valuation placed on the property by the tax commission in assessing it, and that the tax payment offered was based on a valuation lower by that amount than the original assessment. The property of the company is said to have been assessed for 1924 at approximately $26,000,000.

A year ago, J. S. Douglas, president of the company, brought suit in the Federal Court, attacking the method of assessment used by the commission, and seeking an injunction to restrain the tax officials of the state and of Yavapai County from taking steps to collect the taxes until the court action had been settled. The suit asked for a revaluation of the property. This suit was dismissed last spring by Mr. Douglas and the original amount of taxes levied was paid by the company.

Arizona Mining Companies Buy More at Home

Important increases in the use of Arizona products by mining companies of the state are shown in figures compiled by the Arizona Industrial Congress. The United Verde company bought $290,000 worth of Arizona products in July, August, and September, which brings that mine's total purchases for the first nine months of the year to $666,000, an increase of $122,000 over the figure for 1923. Old Dominion's purchases for the three quarters totaled $134,000, and the New Cornelia Co-operative Mercantile Co. at Ajo spent $84,000 for supplies in Arizona during the same period.

California Rand Silver Will Deepen Main Shaft 500 Ft.

The California Rand Silver Co., operating in the Randsburg district, in southern California, has definitely decided to sink its No. 2 shaft an additional 500 ft., thereby giving the mine a depth of 1,567 ft. A crosscut at that level will be driven to determine whether or not there is a recurring zone of ore at that depth. The company's geologist believes that there should be. The work will be started about the first of the year, and mill operation will be suspended for three months or more while sinking is in progress. The company, however, is amply financed to meet operating expenses during cessation of production, and will continue to pay the regular monthly dividend that amounts to 1c. per share.

The company reports that conditions in other parts of the mine are good. The development on the seventh, eighth, ninth and tenth levels in the north end of the mine continues to increase the ore reserves. During October 9,788 tons of ore are milled, the average grade being $27.69. Tailings averaged $1.71. The gross value of 760 tons of concentrates shipped to the Selby smelter was $231,648.

New 500-Ton Mill Planned for Moyie Mine

Plans have been made for the replacement of a mill at the St. Eugene mine, at Moyie, according to reports from Nelson, B. C. The mill on the property was destroyed by fire. The erection of the new mill of 500-ton capacity is for the purpose of treating the ore in the dumps, which aggregate about 1,000,000 tons carrying fair values in silver and lead. The mine belongs to the Consolidated Mining & Smelting Co. of Canada.

Gladstone Does Well

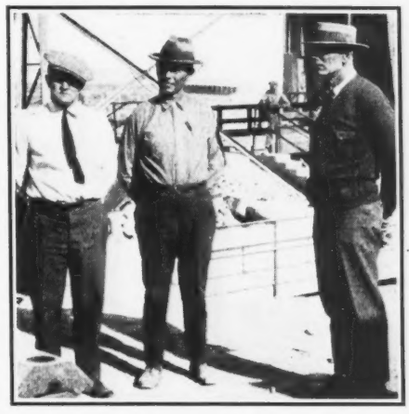
The Gladstone Mining Co. near Northport, Wash., which is mining lead ore and shipping crude to the smelter after a 20-mile haul to the railroad, has accumulated a surplus of $59,000 for the season's work. The ore in the Gladstone does not carry silver, but is unusually high in lead content, containing cerrusite and galena in sufficient quantity to make is very rich.

Calumet & Arizona and New Cornelia Operate on Curtailed Basis

Profits at 13c. Copper Not Satisfactory —Leaching Plant at Ajo Makes Excellent Recovery

The Calumet & Arizona Mining Co. is operating at about 60 per cent of capacity and has been producing copper at the rate of about 3,000,000 lb. a month. In the nine months ended Sept. 30, output amounted to 27,662,000 lb., compared with 30,102,000 lb. in the corresponding period last year. This is in line with the policy of the management not to dissipate its mineral resources on a copper market that barely returns a new dollar for an old. Ore reserves and facilities would permit the company to produce 60,000,000 lb. per year, but being a deep-vein property, its mining costs are higher than those of its subsidiary, the New Cornelia, at Ajo, where 80 per cent of the mining is done with steam shovels. Because of its reduced scale of operation, Calumet & Arizona will show an operating cost for 1924 of about 11c. per lb.

New Cornelia's leaching plant is working efficiently and recovery is satisfactory. The total capacity of the property is 90,000,000 lb. per year, an output pace that will not be attempted until copper prices are substantially higher. In the first nine months of this year New Cornelia produced 43,621,486 lb. of copper, compared with 29,005,706 lb. in the same period last year. The output for 1924 will probably be about 60,000,000 lb., and operating costs are expected to average 8½c. per pound. When depreciation and depletion charges are added, however, the margin of profit on 13c. copper is not satisfactory.

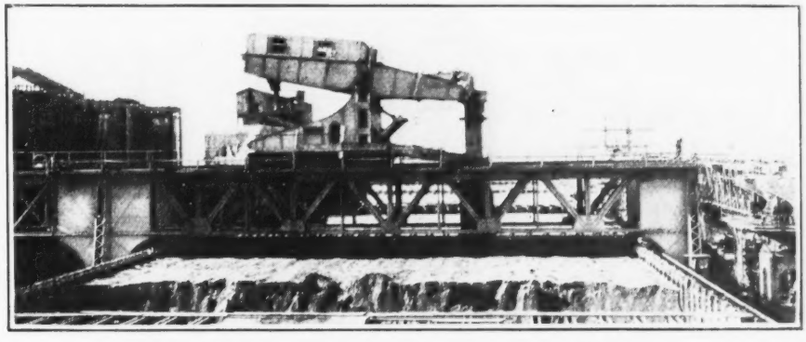


A visitor at Ajo

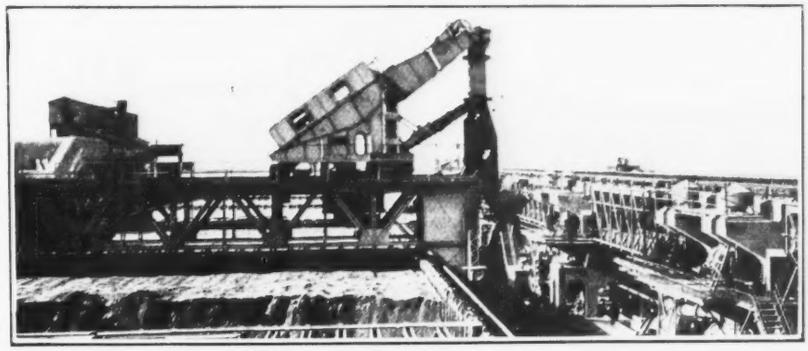
Guy H. Ruggles, superintendent of the Inspiration Consolidated concentrator, on the left, learns about the New Cornelia concentrator from Hans Nelson and J. A. Potter of the New Cornelia staff.

The accompanying photographs show a Hulett unloader at work excavating one of the leaching tanks at New Cornelia's plant. The unloader has a rated capacity of 500 tons per hour, and will generally excavate a tank of tailings in ten to eleven hours. Its bucket has a capacity of twelve tons. Twenty-one to twenty-three train loads of eight cars each are required to remove the tailings from one tank.

Owning 1,200,000 shares of the 1,800,000 shares of New Cornelia outstanding, Calumet & Arizona derives an income of $300,000 from the property each quarter at the present dividend rate of 25c. This amounts to $2 annually on each of Calumet & Arizona's 642,500 shares, or nearly the latter's current dividend requirement of 50c. quarterly.



The unloader being "loaded" with tailing



The unloader discharging into a railway car

Inspiration-Ray Merger Seems To Depend on Agreement as to Terms

Ray Interests Would Not Accept Stock Market Appraisal—Prefer Physical Valuation by Engineers—Production Data

By A. B. Parsons
Assistant Editor

APPARENTLY the consummation of the much discussed merger of the Inspiration Consolidated Copper Co. and the Ray Consolidated Copper Co., which a year ago absorbed the Chino Copper Co., hinges on the ability of the companies to agree on terms. Both appear to consider the merger an excellent plan in principal, and none of the officials denies that negotiations are under way. Naturally each company is anxious to make the best trade possible. However, the appraisal of the properties involved is not complicated as such things go, owing to the comparative accuracy with which the tonnage and grade of the ore reserves can be measured. Accordingly it would not be surprising if the two companies got together during the next few months, in the opinion of leaders in the industry. At the time of the Ray-Chino merger in Wall Street is an exchange of Inspiration shares at around $30 and those of Ray at $15. The following figures show the valuation according to current quotations on the stock exchange:

	Shares Outstanding	Quotation	Total Value
Inspiration	1,181,967	$29	$34,277,043
Ray	3,077,179	16	49,234,864

However, the owners of Ray do not feel that the market reflects the true respective value of the properties. The accompanying table shows data on the ore reserves, production, and costs of the three mines. The tonnage figures for Ray and Chino are taken from the last annual report and the grade of the ore from the most recent report in which assays were given. The figures for Inspiration are estimated, the grade being based on the average of the ore mined during 1923, which was 1.192 per cent, increased to 1.4 per cent on account of the higher tenor of the ore in the Live Oak section. This has just been made available for large-scale mining by the recent completion of the new Porphyry shaft at a cost of about $5,000,000.

Ray-Inspiration Ore-Reserve and Production Data

	Estimated Ore Reserves Jan. 1, 1924 Tons	Grade	Nominal Annual Capacity of Present Plant, Lb.	Production Refined Copper 1923, Lb	Direct Cost of Production 1923	Recovery in Mill 1923, per cent
Ray	79,000,000	2.07%	90,000,000	61,400,000	12.03 c.	74.87
Chino	101,000,000	1.53%	80,000,000	54,300,000	12.90 c.	75.03
Inspiration	65,000,000	1.40%	105,000,000	88,900,000	11.62 c.	75.05

more or less convincing denials were issued up to the last minute before the announcement of the terms was made officially.

The reason for the proposed consolidation is much the same as that advanced for Ray-Chino nuptials. The broad economic advantage of unified control of various producing units is probably the biggest factor. Marketing is the main problem of the copper industry, and of course, production, in so far as output rates affect selling. If the production policies for all three properties were co-ordinated it might be found advantageous to continue major operations at the mine that could produce most economically and curtail elsewhere; or in the event of unfavorable local conditions at one property the others might be operated, so as to make the maximum profit for all of the shareholders.

From a strictly operating standpoint some economies in overhead and organization expense could doubtless be effected. The interchange of technical and administrative skill and talent might be expected to produce some saving. Probably on account of the influential backing of the Anaconda Copper Mining Co., which owns more than one-fourth of the outstanding Inspiration shares, the merger is looked upon, generally, as an absorption of Ray by Inspiration. As a matter of fact the real dominance of the consolidated company would rest with the Ray shareholders. Ray affairs are now directed by the Hayden, Stone-Jackling interests, but it is said in some quarters that they would not be averse to a change.

The basis of negotiation mentioned

Both the Chino and Ray concentrators have been remodeled within the last two years and better results than indicated in the table for 1923, both as to tonnage and recovery, have been made in 1924. The Inspiration company has recently broken ground for a large plant for the leaching of mixed oxide and sulphide ores which will add materially to the potential rate of production and will probably provide for a better recovery. At the same time a revision upward of ore reserves may be necessary when leaching ore is taken into consideration. This may be a very important factor. Chino has had metallurgical difficulties due to oxidized minerals in the ore but these have been in a large measure overcome, it is believed. Chino has an advantage over the other two companies in that 90 per cent of its ore is minable by steam shovels, whereas Ray and Inspiration are underground mines.

The costs as given for Inspiration include depreciation of plant and equipment, but exclude depletion and federal taxes. For Ray the figure includes "the usual charge to cover extinguishment of mine development expenditures which amounts to 15c. per ton of ore, and all operating and fixed and general expenses of every nature, except depreciation of plant and equipment." The Chino figure is "operating cost—exclusive of charge for depreciation." This same figure for the combined Ray-Chino properties for the second quarter of 1924 was only 11.28c. On Jan. 1, 1923 Ray and Chino together had a surplus of quick assets over liabilities of about $8,000,000 as compared with $3,000,000 for Inspiration. Neither company has any bonded indebtedness.

Gossip in the Southwest, as well as in New York, has mentioned other copper producers as likely to be included in consolidations. Among these is the Phelps Dodge Corporation; but only recently officials of that organization took occasion to make specific denial of reports published in Arizona daily papers. They stated that there was no basis for rumors to the effect that "the Phelps Dodge Corporation intended to dispose of its mining holdings."

There is, however, a definite trend toward amalgamation of copper-mining interests. Of already big companies those in control are making bigger ones. No one will be surprised at the announcement of the Ray-Inspiration merger at any time.

Alaska Juneau Again Makes an Operating Profit

Alaska Juneau for October, 1924, reports 291,600 tons mined and trammed to mill from which $193,000 or 66.18c. per ton was recovered. Operating expenses including taxes and sundry totaled $141,000 or 48.35c. per ton, leaving an operating profit of $52,000 or 17.83c. per ton for the month. On capital account $23,700 was expended; Ebner property $2,300 and interest on indebtedness $16,000; total $42,000, leaving a surplus of $10,000 for the month. The third unit to the coarse crushing plant has been about 20 per cent completed and the preliminary work at the Ebner property about 14 per cent completed.

Tintic Standard Forms Subsidiaries to Operate Store and Mill

The Tintic Standard Mining Co. of Eureka, Utah, has organized two subsidiary companies: the Dividend Trading and the Standard Reduction company. The former, capitalized at $177,500, has been organized to take over the new general merchandising business at Dividend, where a suitable building has been erected, and a good stock of goods purchased. The Standard Reduction Company, capitalized at $1,175,000, will operate the company's milling plant. Officers are the same as for the mining company.

Mazapil Copper Co. Locates New Claims in Coahuila

The Mazapil Copper Co. has located about 100 new claims in the Sierra Ramirez, in the vicinity of the Norias de Bajan properties, in Mexico, on which it has acquired a lease and option from Tobias Guzman. It is reported that the Mazapil company will construct a railroad from the main line of the National Railways to these mines. The ore from this region contains a high percentage of lead and some silver. Being an excellent fluxing ore, the output will be sent to the company's lead smelter at Saltillo.

Bureau Works on Low-Grade Iron-Ore Treatment

IN AN EFFORT to be prepared for the day when it will be necessary to resort to lower grade iron ores, the Bureau of Mines is attempting to devise metallurgical processes that will utilize these leaner ores. The application of magnetic concentration to deposits not now being treated by that agency is being studied intensively. Alteration of the magnetic susceptibility of the iron minerals is receiving attention, as are processes for increasing or modifying the characteristic susceptibility of components of the ores capable of being rendered separable. Magnetic concentration, agglomeration, the use of jigs and tables, and the more common concentrating methods, promise important economies by subjecting the low-grade ores to preparatory treatment, thereby reducing the burden on blast furnaces.

Ahmeek Now at 75 Per Cent of Maximum Capacity

Ahmeek, in the Michigan copper district, which has increased production somewhat of late due to larger underground forces, is now on an output basis of 75 per cent of capacity, operating six of the eight stamps in the stamp mill. Each stamp is treating between 500 and 600 tons per day. Ahmeek is being extensively opened, preparing for the day when capacity production will be required. Sinking and drifting are under way in Nos. 2 and 3 and 4 shafts. The fissure vein in No. 2 has been opened on several new levels and an extensive area opened to the south in Allouez territory. All of this ground is being held in reserve. The fissure vein is being mined on the 20th, 21st, 25th and 26th levels of No. 2 shaft, yielding approximately 120,000 lb. of refined copper per month. The 17th level crosscut, west, which was driven to cut the Osceola lode, is approaching the Calumet conglomerate, which should be encountered about the first of the year. No values were found in the Osceola vein.

Will Try to Reorganize Idaho Gold & Ruby

The sale of all claims, machinery, and equipment of the Idaho Gold & Ruby Mining Co. at Leonia, Idaho, will be held at the mine on Dec. 6. The sale has been ordered by the receiver of the company, and no bid under $100,000 will be considered; $25,000 must be paid on the date of sale.

Plans for reorganization of the old Idaho Gold & Ruby Mining Co. are being rapidly perfected by a committee of large stockholders, who are forming a pool to bid in the property at the receiver's sale. All stockholders have been invited to come into the reorganization, which will have a capitalization of $1,000,000.

Comstock Merger Buys United Comstock

Transaction Virtually Consummated—Gets Huge Milling and Cyanide Plant—Another Chapter in Exploitation of Old Comstock Lode Mines

BARRING some unforeseen hitch, the Comstock Merger Mines Co. will be the owner of the property and assets of the United Comstock Mines Co. at Virginia City, Nev., before the end of the week. As this is written the papers are not signed, sealed, and delivered, but high officials of both companies admit that the sale is virtually consummated. T. C. Baker, assistant manager for the Mexican Corporation, in Mexico, has left Fresnillo, Zacatecas, for Virginia City to assume resident managership for the Comstock Merger Mines Co.

The United Comstock Mines Co. was organized about six years ago as a subsidiary of the Metals Exploration Co., of which Bulkeley Wells was the dominant figure. The plan was to exploit low-grade ore, including stope fillings, in a group of the old Comstock lode properties at the south or Gold Hill end of the district. A mill with a nominal capacity of 2,000 tons per day and costing several million dollars was erected and put into operation late in 1922. The driving of a two-mile adit to tap the ore-bodies was completed at about the same time. The results of operations, however, were disappointing and in spite of various changes in the mine and mill no money was made. The Metals Exploration Co. was reorganized, and R. H. Channing, Jr., took charge of operations, in August, 1923. Under his guidance policies were changed and economies were effected so that a small operating profit was realized.

In the meantime the so-called Middle Mines group, lying north of the United Comstock properties, was consolidated by Alex Wise and associates. Various exploration companies examined the property, and finally the Comstock Merger Mines Co. passed into the hands of British interests allied with the Mexican Corporation and the Consolidated Gold Fields of South Africa, which, under the terms of an option, had conducted a systematic campaign of exploration. It is said that more than half a million dollars was spent and that a fair tonnage of ore was developed.

As the ore reserves of the United Comstock Co. were "limited," it became apparent that a merger of the two companies was logical. Negotiations have been under way at intervals for many months. The present plan is based on the sale of the United Comstock property, lock, stock, and barrel. The terms have not yet been made public, but doubtless the Comstock Merger gets a milling plant at much less than the replacement cost, in addition to mining property from which considerable ore may yet be mined.

Leadville Deep Mines Renews Equipment; Continues Pumping

Unwatering of the Graham Park Basin at Leadville, which has been in progress for the past year by the Leadville Deep Mines Co. has been retarded the past month by an unexpected heavy inflow of water from the deeper horizons. The water has been lowered to a point 1,230 ft. below the collar of the shaft, but on account of the heavy flow at this point little progress has been made the last two months, and additional pumping facilities are being installed.

It has been necessary, after more than a year's continued and heavy service, to overhaul the electric pumping service and to renew or repair worn-out equipment, most of which has been accomplished; and with the additional pump it is expected that the unwatering of these properties will be completed before the end of the year, and that development and production will rapidly follow.

New Mill on Diamond Joe

The Vinegar Hill Zinc Co. has decided to build a mill on its Diamond Joe lease, two miles south of Baxter Springs, Kan., recently obtained from Charles Malsbury. The company has carried on considerable drilling on the lease, taking it over some time ago, and expects to start a new shaft as soon as the power plant, now being installed, is completed.

Nevada-Rand Ships Again

During October the Nevada-Rand mine, in Mineral County, Nev., produced 110 tons of ore that netted $6,385 from the smelter. V. W. Rudderow, manager of the mine, says that the ore came from the 250 level. A crosscut at the depth of 350 ft. has been started with the expectation of cutting the ore-body at a point 100 ft. lower down.

Superior Copper Co.'s Affairs Wound Up for Good

Affairs of the Superior Copper Co., a subsidiary of Calumet & Hecla Consolidated in the Michigan copper district, will be wound up and disposition made of the assets at a stockholders' meeting Dec. 15 in Boston. Superior's balance of current assets Jan. 1, 1924, was $174,648.36. The initial liquidating dividend was paid Dec. 29, 1922, amounting to $2 per share or $200,000. Calumet & Hecla Consolidated owns 50,100 shares of the 100,000 issued. Dividends of $1 per share were paid in 1916 and 1917. Superior was mined out in 1920 and will not again be opened. The unmined area has been thoroughly explored but the ground has been found badly faulted and the lodes poor and irregular. The formation is of such character as to offer no inducement for further expenditure. All underground equipment of value was brought to surface late in 1920, the machinery on surface taken apart and stored.

Teck-Hughes Realized $609,000 Operating Profit in 1923

Recovery $26.97; Costs $12.60 Per Ton —Increased Ore Reserve but Gives No Figures

The report of the Teck-Hughes Gold Mines of Kirkland Lake, Ont., for the year ending Aug. 31, shows that 42,381 tons of ore were treated, with a recovery of $1,111,674, or an average of $26.97 per ton. The net operating profit was $609,000 or $14.37 per ton. After setting up a reserve for taxes, the net amount carried to surplus was $576,253, making a total surplus of $879,710, of which $716,000 represents cash and bullion. During the year bonds to the amount of $176,000 were paid off and the only liabilities are now current liabilities of $110,867. Operating costs were $12.07, while other charges brought this up to $12.60 a ton. Included in the costs is $29,695 spent in sinking the deep shaft. Diamond drilling has indicated the existence of good ore at least 600 ft. below the present workings on the tenth level, the last hole drilled showing 8½ ft. of $43 ore, while north of this another intersection was obtained giving 3 ft. of $22.40 ore. It is stated that as a result of development during the year, the ore reserves above the tenth level are considerably greater than they were at the beginning of the year, but no actual figures as to ore reserves are given.

Pennsylvania Mines Co. Has Trouble With Smelter

The Pennsylvania Mines Co., operating the Wanohkah mines at Ouray, Colo., is meeting with difficulty in the initial operation of its new 50-ton smelter, but, according to the management, no more than is usual with a new installation of this kind.

Remedial changes are being made at the plant with a view to overcoming the difficulty. A good force of men is being employed in the mines.

Wm. Sloan States Growth in British Columbian Metal Output

Speaking before the Provincial Legislature of British Columbia, which convened Nov. 3, Wm. Sloan, Minister of Mines, pointed to the enormous advance in British Columbia's outputs of lead and zinc in the last few years. He said: "The zinc output has jumped from 49,000,000 lb. in 1921 to 58,000,000 lb. in 1923; and the first half of this year witnessed a production of 29,500,000 lb. We expect the zinc output for this year to be close to 60,000,000 lb. When we look at the lead production our progress is even more remarkable. The output of the Province has risen from 41,000,000 lb. in 1921 to 96,000,000 lb. in 1923. During the first half of this year Canada's production of lead was 79,000,000 lb., of which British Columbia produced 75,000,000 lb. If the same pace is maintained throughout the year our production will be 150,000,000 lb." The Minister predicted that the copper production for this year would be about 60,000,000 lb.

News from Washington

By PAUL WOOTON
Special Correspondent

Magnesite Producers Protest Tariff Commission's Delay

Only Six of Forty Mines Operate—Duty Increase Would Create Competitive Market

PRODUCERS of magnesite in California and Washington are at a loss to understand the delay on the part of the U. S. Tariff Commission in investigating costs of production abroad. At a tariff commission hearing a year ago, the domestic producers laid all their cards on the table and the commission has made a thorough check of domestic producing costs. The foreign producers, who early in 1923 filed an application for a reduction in the duty, failed to put in an appearance at the hearing and have revealed none of their figures, either by brief or through counsel.

Of the forty developed magnesite mines in the United States only six can operate. Insofar as caustic magnesite is concerned the entire east, the principal consuming territory, is in the hands of foreign producers. They compete successfully with the domestic product as far west as Chicago.

Such evidence as is available indicates that the Austrian and Czechoslovakian production of dead-burned magnesite can be laid down at North Atlantic ports for $6 per ton, or less before the duty is paid. Domestic costs at present are around $18 per ton. Costs could be reduced materially, however, were domestic producers in a position to use the entire plant capacity. The domestic supplies of the material are large and the quality of the output is entirely comparable to the imported product. Furnace lining contributes so little to the cost of steel that an increase in the duty would be a negligible factor in the price which would be paid by the ultimate consumer. The steel makers are giving abundant evidence of their ability to use the American product as readily as that produced abroad. Apparently their marked disinclination to turn to domestic supplies entirely is actuated by a desire not to surrender their investment in the foreign properties.

The situation with regard to caustic magnesite is even more important. This material finds its principal market in the large cities of the East, where the domestic product cannot enter at present. The importers have absorbed 60 per cent of the duty and are thought to be in a position to absorb more of it should it become necessary.

The foreign production comes largely from the cheap labor countries of Greece and British India. It is calcined and ground in Germany, Holland and Scotland, prior to its being forwarded to this country. If it is the idea of a protective tariff to establish conditions under which domestic producers can compete, the western producers argue that there is crying need for a readjustment in the duties on magnesite. At any rate, they see no reason why the Tariff Commission should not proceed with the study of foreign costs. In that connection it may be stated that the securing of foreign costs is a relatively simple matter, as any refusal or failure to contribute accurate information in that regard would make applicable the provision of the law which provides for an embargo against the product. There is a feeling that the Tariff Commission has not been duly diligent in the case of magnesite. It seems to be able to pursue vigorously the investigation of foreign costs of straw hats, bentwood chairs, print rollers for wall paper, and gold leaf, yet has failed to show the same enterprise in connection with what is evidently a much more important commodity.

Bureau Can Use Mining Engineers at $2,400 to $3,800

The U. S. Civil Service Commission announces competitive examinations to fill vacancies in the U. S. Bureau of Mines as mining engineer. Starting salaries range from $3,800 down to $2,400 for assistant mining engineer. Education and experience are weighted at 70 and publications and reports at 30. The duties of the position will be to supervise and make investigations and reports concerning various phases of the mining industry. Applicants must be under forty-five years of age and need not report at any specific place for examination. Details regarding the examinations may be had from the Civil Service Commission in Washington, D. C., or from branch offices at Boston, New York, New Orleans, Philadelphia, Atlanta, Cincinnati, Chicago, Seattle, San Francisco, Denver, or St. Louis. The receipt of applications closes on Dec. 9.

Explosives Manufacturing Expands

Explosives manufactured in 1923 exceeded by 26.8 per cent the output of 1921, figures just made public by the Bureau of the Census show. The number of men employed in the industry increased 42.7 per cent. The amount paid for wages was 37.8 per cent greater and the cost of raw materials was 28.9 per cent greater. One of the striking features of the Census return was the increase of 82.9 per cent in the output of permissible explosives. In 1923 the total output was 67,334.759 lb. There was a large increase in the output of dynamite, which in 1923 amounted to 262,290,012 lb., an increase of 56.8 over 1921.

Co-operative Curtailment of Oil Development—G. O. Smith

Step Toward Conservation of Resources —Naval Reserves Involved with Public Interest

Waste of oil has reached such proportions that the Federal Government is preparing to move in an effort to prevent it. Judging from pronouncements by Dr. George Otis Smith, the Government has in mind some form of co-operation with the industry to that end. Dr. Smith, in addition to his duties as Director of the U. S. Geological Survey, is the head of the President's Commission charged with the working out of a systematic policy for the handling of naval reserves. Since it is impossible to divorce the petroleum interests of the navy from the petroleum interests of the people as a whole, the work of the President's commission is certain to deal with the conservation of our oil resources in a broader sense.

There is a feeling in the industry that this commission will work out a practical plan rather than recommend some form of political action which is likely to be destructive. That the commission is working along the lines of co-operation with the men in the oil industry is revealed by Dr. Smith's utterances at Tulsa. It has become increasingly evident in other quarters that the time is ripe for a larger degree of co-operative rather than antagonistic action in the production end of the petroleum business. One straw which indicates the trend is the favorable comment in the press of the appeal for such joint action made by Dr. Smith. His contention is that since competitive ownership is the stimulus to wasteful haste in bringing oil to the surface, once that a pool is discovered, regardless of the requirements of the current market, the remedy lies in co-operative action.

There is natural hesitancy on the part of some oil men arising from doubts as to the legality of any approach toward combined or joint action, but Dr. Smith said at Tulsa that to put some limit upon excessive development and consequent over production would not be a combination in restraint of trade, but a combination in restraint of waste.

Reverberatory "Side Feeding" Patent Suit Appealed

In San Francisco on Oct. 31, attorneys for George C. Carson, who claims to be the inventor of side feeding for reverberatory copper-smelting furnaces, appealed from the recent decision given in favor of the American Smelting & Refining Co. The American Smelting & Refining Co. maintains that the Siemen's patent anticipated the Carson patents. The case is of considerable importance to the mining industry, as the practice of side-feeding reverberatories has been systematically developed and widely used. The controversy is obscure, as authentic recording of the first use of side feeding appears to be lacking or uncertain as to the inventor or first user. H. L. Charles claims to have invented the first system of side feeding.

Bain Will Make Iron-Ore Survey for Argentina

Accompanied by C. E. Williams, the superintendent of the mining experiment station at Seattle, and by E. B. Swanson, assistant to the director of the Bureau of Mines, H. Foster Bain, the Bureau of Mines Director, will sail

H. Foster Bain

from New York Nov. 22, for Argentine to make a study of the possibilities of developing an iron and steel industry in that country. This assignment is being undertaken by Dr. Bain and his assistants at the specific request of the Argentine Government. The survey will include economic studies as to the feasibility of the enterprise, as well as examinations of the necessary mineral raw materials.

Before sailing Dr. Bain will spend some days in New York getting data. During his absence, Dorsey A. Lyon will be the acting director of the Bureau of Mines.

Dominion Silver-Lead Cuts Ore on 750 Level

The Dominion Silver-Lead Mining Co., operating the Old Dominion mine, near Colville, Wash., is steadily adding to its ore reserves. At the 750 level has been cut the extension of the oreshoot from which production is maintained on the 650 level. Prospecting with a "long-hole" drill has exposed other orebodies in the workings of the mine, so that a large tonnage of first-class and milling ore is available for mining. In thirty days the net returns from the smelter amounted to $39,000. The ore is high-grade silver-lead.

More Activity at Tombstone

Mining activity at Tombstone, Ariz., is increasing. The various lessees are shipping an average of 30 cars of ore monthly. The Old Maid Mining Co., whose property is located about four miles from Bouse, has installed a 12-hp gasoline hoist and is planning to sink the No. 1 shaft to 200 ft. The shaft is now down 45 ft. and is said to have opened up a 12-in. vein of gold ore averaging $45 per ton. The No. 2 shaft is down 30 ft. where another promising vein has been uncovered. A Denver syndicate has optioned the old Mohawk mine.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Tough-Oakes Bullion Returns Don't Check Ore Assays

Milling Will Continue—New Manager Takes Charge—More Development Necessary

Toronto, Nov. 17—Recently, some further illumination has been thrown on the position of the Tough-Oakes property of Kirkland, by the statement issued by the President, in which the shareholders are informed that the assays of the ore have not been confirmed by the milling returns and that further development is necessary before definite valuation of the orebodies can be made. During the period between June 1 and Oct. 31, 10,000 tons of ore was broken and from the milling operations which commenced Sept. 22, $21,000 was recovered up to the end of October. The statement does not give the tonnage treated, but it is understood to have been approximately 3,000 tons, which would indicate a grade of around $7 a ton. As a considerable tonnage of ore has been accumulated on the surface and in the stopes, it is proposed to continue milling operations and the revenue is expected to cover the cost of production and contribute toward the cost of completing the proposed development program.

W. B. McDougall has resigned as manager and Allan Stuart is taking his place. A Canadian consulting engineer will be appointed. It is the general impression that it is too soon to form any positive ideas and that one month's mill run is hardly likely to give sufficient data on which to base an estimate of the possibilities of the mine. The oreshoots in the Tough-Oakes are smaller than in most mines throughout the camp.

The vein encountered a few months ago on the Wright-Hargreaves property has been drifted on for a total length of 600 ft. and shows an average grade of approximately $20 a ton over a width of about 5 ft. This ore has had an appreciable affect on the mill heads and up to the end of October the production for the present year was equal to that of the twelve months in 1923. It is estimated that this year the output will be approximately $1,000,000. At the present time the mill is treating 225 tons a day and the heads are averaging about $15 a ton. Early in 1925 the tonnage treated will be doubled.

During October the Nipissing mined ore of an estimated net value of $177,000 and shipped bullion of an estimated net value of $185,000, the average price of silver being taken at 69½c. A new vein showing 3,000 oz. per ton over a width of 2 in. was found in the workings of 63 shaft and it is expected that a substantial production will result. The high-grade plant was not in operation during the month, but the refinery shipped 262,581 oz. of bullion.

The production of the Keeley mine for October amounted to 126,000 oz. of silver and 22,500 lb. of cobalt. This is a slight increase over the preceding

month. On the ninth or 620 level an oreshoot 32 ft. long averaging 800 oz. over a width of 2 in. was opened up on the Woods vein and on the No. 16 vein a short shoot averaging 1,000 oz. over 4 in. was found.

Production from the Dome Mines in October was $355,000 from 43,800 tons of ore, an average recovery of $8.18 a ton. This is a decrease of about $5,000, as compared with the previous month, although the tonnage treated was about 2,000 tons greater.

London Letter

By W. A. Doman

Special Correspondent

General Elections, Strangely, Give Fillip to Mining Shares

Copper and Gold Stocks Lead—Engineers Look for Engagements—Good Engineers and Doubtful Directors

London, Nov. 4—General elections are responsible for many things, but it is passing strange that the latest election in this country should cause a rise in mining shares. Yet so it is. The public are as keen on buying them as they are to acquire an interest in railway or industrial stocks. An election cannot affect the mines, as they are situated in other countries. The only explanation seems to be that as there is the possibility of a stable government and political peace, investors and speculators have more courage in venturing their capital. With strong markets purse strings will be unloosed, and savings be made available for new enterprises.

So far as can be gathered, few mining flotations are in preparation, though some companies are considering the question of enlarging their capital. The expected greater consumption of metals, and their advancing prices, are playing their part in the creation of interest, of which mining directors will in due course take advantage. Copper and tin are first on the list, with gold, silver, and lead closely following.

Many mining engineers are still awaiting engagements, and some of them are filling up their time by contributing articles to the technical press. It may be regarded as unfortunate that firms or consulting engineers occasionally become connected with companies whose directors are not of the highest standing. For this no blame can perhaps be attached to them, for, as they say, they are responsible only for the technical work. Companies could be mentioned with first-class engineers whose shares even brokers will not recommend.

There is some talk that Ropp Tin (Nigeria) shares, of the nominal value of 4s. and now standing at rather over 15s., are fully valued. Hitherto rich ground has been worked and the company has reserves for the next four years or so. The disappointment comes in the rumor that the limits of the rich ground have been determined and that outside of it poor ground is being developed. The Ropp is a well-managed undertaking, but even the best mines are likely to strike a bad patch at some time.

Apparently the introduction of water-power by the Chenderiang Tin Dredging, Ltd., (Straits Settlements), is proving successful. The F. M. S. Government granted a hydraulic license to the company for the use of the Kinjang Falls, and all the material for the installation was shipped by August last. A first test of the line was made last month. By the middle of the current month all the water-power generated is expected to be in use. As the company has not paid a dividend since 1920, it is hoped that with the introduction of the hydraulic system expenses will be lowered, and that with the present high price of tin—no one looks for much in the way of a fall—profits should improve and a resumption of dividends take place.

The British Malayan Tin Syndicate, of which Sir Ernest Birch is chairman, will soon put before the public a company for dealing with a new property—the Selayang Tin Dredging. Check boring has been done on this property, but the results have not come up to expectations. No importance is attached to this fact, owing to the smallness of the bore and to the experience that tin is not distributed evenly in the Malay Peninsula.

Henry Ford Continues Search for Iron and Lead

The Ford Motor Co. continues to diamond drill for iron ore in Michigan, but nothing has been given out concerning the results. At present the company has one drill working near the old Riverside mine, near Republic; one close to the old Beaufort property, at Michigamme, and two near the Taylor mine, not far from L'Anse. Drilling is also being carried on at the Imperial mine, the only iron mine now being operated by the Ford company. The Taylor was originally opened as an iron mine, but during the summer months of late years it has been a producer of graphite. This product is hauled on sleighs during the winter months to the railroad and shipped to Detroit for manufacture into paints. There is an iron-ore formation and this is to be thoroughly tested by Ford.

The Ford company discontinued work recently at Arvon, where it owns a slate quarry. Ford wants slate for switchboards, but the Arvon product did not come up to expectations and the project has been closed. At present the company has an engineer in a western state looking for the kind of slate desired. Drilling still continues in the lead district in southeastern Missouri.

New York Company Contracts for Arizona Asbestos

The Asbestos, Ltd. of New York, through the Arizona Industrial Congress, it is reported, has contracted for the output for the next nine months and the stock on hand of the San Carlos Asbestos Co. which operates an asbestos mine about 45 miles from Springerville, Ariz., in the White Mountains. The Arizona product is said to be the only asbestos in this country now being mined on a commercial basis.

Johannesburg Letter

By John Watson

Special Correspondent

Government Areas Netted £203,144 in September

Production for Rand Lower Than in August—Shaft-Sinking Record for South Africa

Johannesburg, Oct. 13—The following crushing results for the month of September, from the leading profit-earning gold mines of the Rand, have recently been published:

	Tons Crushed	Value or Revenue	Costs per Ton Milled		Estimated Profit
		£	s.	d.	£
Government Areas.....	159,000	335,840	17	1.2	203,144
New Modder.	123,000	267,981	17	6.2	160,236
Crown Mines.	208,000	287,314	19	6.0	84,471
Van Ryn Deep	67,500	136,328	18	5.1	75,044
Modder Deep.	44,100	106,738	15	11.0	71,576
City Deep....	95,000	174,197	22	5.4	67,571
Springs.....	65,200	126,118	20	8.2	66,311
Modder B....	66,000	119,746	18	4.0	59,248
Randfontein Estates.....	201,000	234,523	18	5.9	54,889
Geduld.....	69,000	110,829	18	7.0	46,588
Robinson Deep	75,000	.....	17	0.9	45,631
Brakpan.....	69,000	112,806	21	11.8	43,757
New State Areas.....	65,000	110,256	21	4.2	41,172

The Transvaal gold output for the month of September was declared by the Chamber of Mines, on Oct. 10, as 799,422 oz. having a realizable value of £3,677,341. Compared with August, these figures show a decrease of 10,149 oz. in quantity and a decrease in value of £6,207. The number of working days in September was 26, the same as in August. The daily average output was 30,747 oz. or 390 oz. per day less than in August. The price realized for gold was 92s. per ounce for September, which was 1s. per fine ounce higher than the August price. The native labor return shows 1,636 more "boys" at work on the gold mines at the end of September, than were employed at the end of August.

A world's record in sinking a large circular shaft is claimed to have been established at the New Modder Gold Mine by Ivor Rees, where 303 ft. of ground were sunk through and excavated in thirty days. Mr. Rees held the previous record of 310 ft. in thirty-one days. The men worked shifts of eight hours day and night; progress varied in the twenty-four hours from 8 to 13½ ft. The shaft is 21 ft. 6 in. in diameter, and sinking started on Jan. 11. The shaft is now 1,800 ft. deep, and it is intended to sink another 900 ft. This is the tenth shaft sunk in South Africa by Ivor Rees.

The British Empire Parliamentary Association arrived in Johannesburg on Oct. 10. Viscount Burnham, chief proprietor of the *Daily Telegraph*, London, said the delegation's tour of South Africa had been a noteworthy success, as showing the resources and possibilities for development of this subcontinent. The delegates paid a visit to the Crown Mines, where they descended 3,000 ft. in a cage and made a further descent of 2,000 ft. in a huge sinking bucket, to the bottom of a new shaft.

Men You Should Know About

Oscar H. Hershey has returned to San Francisco from a mine examination trip to Sinaloa, Mexico.

J. Mackintosh Bell is making an examination of the Cobalt Contact mine in Bucke Township, Ontario.

Garrett Mott, president of the Castle Dome company, is visiting the company's property near Globe, Ariz.

Charles A. Mitke is on a professional visit to the mines of the Cia. de Santa Gertrudis, at Pachuca, Hidalgo, Mexico.

John G. Kirchen, general manager of the Tonopah Extension Mining Co., has returned to Tonopah, Nev., from San Francisco.

Dr. Charles Camsell, Canadian Deputy Minister of Mines, has returned to Ottawa from a visit to British Columbia.

H. L. Payne was recently a visitor in Salt Lake, on his way to Arriosa, Utah, where he investigated some of the saline deposits.

J. B. Mertin, Jr., of the U. S. Geological Survey, is again in Washington after having spent the field season in northern Alaska.

H. C. Dudley, mining engineer, has returned to Duluth from a professional journey to northern Mexico, including a visit to the Ahumada mine.

P. McDonald has been placed in charge of operations at the Atlas gold mine, West Shining Tree, Ontario, where development has been resumed.

J. M. Stuart, representing the English interests controlling the Tough-Oakes Burnside mine, is in Kirkland Lake, Ontario, making an inspection of the property.

C. Q. Schlereth, of the firm of Whitaker and Schlereth, mining engineers, has been appointed general manager of the Potosi Mining Co. and the Calera Mining Co., at Chihuahua, Mexico.

D. S. Calland, managing director of the Cia. de Real del Monte, has recently returned to Pachuca, Mexico, from a business trip to the headquarters of the U. S. Smelting & Refining Co., in Boston, Mass.

Carlos A. Hieber has been elected a director and manager of operations for the St. Louis Mining & Milling Co., of Montana, operating the famous old Drumlummon mine and cyanide plant at Marysville.

Fernand Pisart, manager of the sales and refining department of the Katanga properties, and managing director of the Société Générale des Minerals, of Brussels, has been inspecting the Butte mines and the smelter at Anaconda.

R. S. Baverstock, after attending the Mining Convention at Sacramento, visited the Palisades mine, at Calistoga, Calif., which is being reopened, and afterward visited the Cherry Hill and some other mines in the quicksilver belt.

A. R. F. Penrose, Jr., has been elected a director of the Kennecott Copper Co., to take the place of Samuel J. Clark, resigned. Mr. Penrose is one of the men responsible for the development of the Utah Copper Co.'s properties.

Thomas K. Scott, mining engineer has been appointed Mid-West sales manager of the Taylor-Wharton Iron & Steel Co. He will make his headquarters at Denver, in charge of the sales district of which Denver is the center. Mr. Scott has had a wide and profitable experience in mining. He entered Columbia School of Mines in 1904, but left before completing his course in order to take up work for the

Thomas K. Scott

Cumberland Ely Copper Co., of Nevada. In 1908 he re-entered Columbia and completed his course, receiving the degree of Engineer of Mines. Besides the Cumberland Ely he also has been connected with the Inspiration Copper Co. and the Miami Copper Co. He was chief mining engineer of Miami up to the time of his resignation last August.

Dr. William H. Davis, geographer and geologist of Harvard University, will lecture to the students of the University of Arizona at Tucson on Nov. 24. The subject of Dr. Davis' lecture will be "The Evolution of Desert Lands."

Walter Douglas, president of Phelps Dodge Corporation, and a member of the executive board of the Southern Pacific Ry. Co., attended the thirty-sixth annual convention of the National Association of Railway and Utilities Commissioners, held in Phoenix, Ariz., early in November.

Frederick Ledoux, president of the Penarroya company of France, the largest French producers of lead, and **Ferdinand Leferrer** and **Henry Jequier,** metallurgical engineers, have been studying the metallurgical methods used at the Great Falls plant of the Anaconda Copper Mining Co.

Grant Mahood, accompanied by **Joseph A. Mills,** one of the directors and consulting engineers of the British American Holding & Development Co., of New York, recently returned to Stewart, B. C. It is their intention to explore and develop the orebodies already opened up on Fish and Georgia River properties in the Portland Canal district.

T. A. Moate, chairman of directors of the Adelaide Oil Exploration Co., of South Australia, has returned to Australia after an extensive tour covering large areas of South and Central America, New Zealand, and the Pacific islands. Mr. Moate's trip had for its purpose an investigation of the continent of South America as a source for the production of petroleum.

F. E. Godson, Mining Commissioner for Ontario, has been appointed a judge of the Superior Court. Some of his decisions as commissioner were overruled on the ground that he had gone beyond his jurisdiction, and that the cases could be decided only by a judge with authority given by the Federal Government. This has now been conferred upon Mr. Godson, who will have a considerably extended jurisdiction, including cases regarding patented mining lands.

P. G. Beckett, formerly general manager of the Phelps Dodge Corporation, with offices at Douglas, Ariz., has been appointed to serve as vice-president of the corporation. Mr. Beckett came to Arizona as an engineer for the Copper Queen mines in 1904, later going to South America for a brief interval. On his return he was made manager of the Old Dominion company, in Globe, Ariz., and in 1920 was appointed general manager of the Phelps Dodge properties, with headquarters in Douglas.

Obituary

H. E. Sharpe, mining engineer, was killed at Mokelumne Hill, Calif., on Nov. 10, in a cave-in in the shaft of the Nuner mine. Before becoming unconscious he requested that no publicity be given to his death. He made no mention of home or relatives and fellow workmen know little of him.

John J. Barrett, aged seventy years, prominent mining engineer, died at St. John's Hospital, Helena, Mont., on Nov. 8, 1924, following a short illness. He was born in St. Catherines, Ont., and for many years was engaged in business at Erie, Pa., removing to Butte, Mont., about forty-five years ago to become a mining engineer. He was a member of the Civil Engineers' Association and of the Helena Lodge, B. P. O. E.

Cornelius Cole, a centenarian pioneer of California, died in Los Angeles on Nov. 3, 1924. He reached the age of 102 years on Sept. 17, 1924. At twenty-six years of age he formed one of a group of men who reached California in 1849. He mined for gold near Auburn and played a part in the organization of Sacramento County. He continued his career as a lawyer after his initial adventure in gold mining. Cole formed one of a group of men who met in the law office of Collis P. Huntington and Mark Hopkins in Sacramento to organize the Central Pacific R.R. Co. As a member of Congress, later, he aided in bringing about legislation that made possible the construction of a transcontinental railroad. He was a close personal friend of Abraham Lincoln and was the only man on the platform with Lincoln when the President delivered his Gettysburg address.

Societies, Addresses, and Reports

Mining Activities in Oregon

Henry M. Parks Reviews Work at Important Active Properties, at Portland Meeting of A. I. M. E.

At a joint meeting of the North Pacific Coast, Columbia, and Oregon sections of the A.I.M.E., held at Portland on Nov. 7, Henry M. Parks, consulting geologist and mining engineer of Portland, read an interesting paper summarizing the mineral occurrences of Oregon, the history of their development, and the present operations. In reviewing the important active properties of the state, Mr. Parks spoke in part as follows:

"In the Cornucopia district Mr. Betts is operating the Union mill at about seventy tons' capacity on ore from the Last Chance mine. The Simmons property is under bond and lease, and recent work has shown a good tonnage of fine milling ore. The Queen mine, operated by the Gold Reef Mining Co., has just begun development again after a few months' shutdown. The Mother Lode Copper Co., which is developing the Poorman mine, east of Baker, recently opened some remarkable orebodies, which are of exceptional interest on account of the fact that they carry good values in gold and silver along with the copper. The E. & E., in the Sumpter district, is again in operation under the management of P. J. Jennings. The Ibex is milling about fifty tons per day. This property has good ore reserves. Robert M. Betts is consulting engineer.

"The La Belle View is operating again with a good-sized crew, and it is reported that the mill is about ready to begin operations. The ore is to be roasted and cyanided instead of the usual fine grinding followed by cyanidation. Mr. Graves, of the Montana Assay Office, is consulting metallurgist. The plant has recently been started, but the results have not yet been announced.

"The Buffalo mine is being operated under lease. The property is under the management of G. E. Stowell.

"The Iron Dyke, on the Snake River, 60 miles above Huntington, is operated steadily by Miller and Carter under lease. Recently they shipped ten cars of ore worth $1,000 per car. This property has been Oregon's chief copper producer for the last twelve years.

"The Bay Horse, on the Snake River, 9 miles below Huntington, is one of the most important developments in eastern Oregon in recent years. The orebody is mineralized andesite and rhyolite, the ore minerals being ruby silver and gray copper. The orebody, so far as developed, varies from 25 to 50 ft. wide. More than $200,000 has been received from smelter returns on ore taken out in development work. The property is about ready for a mill and C. N. Anderson is in the East engaged in financing the milling plant. Sixty men are at work building a wagon road to the Red Ledge, on the Idaho side of the Snake River, about 100 miles below Huntington.

"Powder River dredge, at Sumpter, has quit for good. There is no more profitable ground to be bought. This company's operations have extended over a period of about fifteen years. They have dredged approximately 1,000 acres. The commercial gravel was found to be in a meandering stream channel from 300 to 2,000 ft. wide and for a length of more than 6 miles. The dismantling of the second dredge brings to a close Oregon's principal gold producer during the last decade.

"The Baisly Elkhorn, idle for fifteen years was recently reopened under the management of P. J. Jennings. It is reported that the property is inactive.

"In southern Oregon, less substantial mining and development work is in progress than in the eastern part of the state. Fred Bartels and associates have been for the last two years developing a good gold property in the Bohemia district. Harry Sordy is developing the Oriole mine, in the Galice district. The Millionaire gold property, a few miles east of Gold Hill, has been recently developed further, and it is reported that a good tonnage of milling ore is available. The Sylvanite, just north of Gold Hill, is planning to erect a mill.

"There is considerable talk of building a custom smelter at Gold Hill, but this effort is not yet taken seriously. A few days ago I had a conference with the secretary of the smelting company and as nearly as I can tell the company is planning to smelt copper, zinc, and antimony sulphides in the proposed smelter, all at the same time. He did not have time to tell me all of the interesting features of this wonderful furnace, but I think that a special tap is to be provided whereby it is expected to draw off some of the other common southern Oregon metals, such as platinum, iridium, and occasionally tin. I think the only thing lacking to make such a furnace run smoothly would be to use as fuel some of the Rev. Olsen's 50 ft. of solid paraffin which it is said has been found in the Lane County oil well. It should be stated, in passing, that Rev. Olsen located the extraordinary oil well by means of a hazel switch.

"Ever since the eleventh century men have claimed to be able to detect the presence of metals, underground water, and, of late, oil, by means of a pronged hazel branch in the shape of the letter Y, each hand grasping one of the prongs in such a way that the stem was free to turn either way. When they stood over the ore, vein of water, oil or pool the branch twisted over until it pointed to the mineral sought. As mining engineers, we will agree with Hamlet that, 'There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy.'

"In southern Oregon are numerous diviners, fakers, or what-not, some of whom claim to be able to find oil with a pronged stick; others who report spurious values in platinum and the platinum group to the prospector, causing him to come back with many repeat samples. I believe it was Cicero who said of the augurs and diviners of his day, that he could not see how two of them could meet in the street and look each other in the face without laughing.

"It is quite within the range of possibility that honest scientific investigation may succeed in devising a way of obtaining guidance for the prospector and miner. Some progress by which he may determine both qualitatively and quantitatively the presence of ore at some distance underground is already indicated in this direction by the practical use of such devices as the dip needle. Meanwhile, however, it remains for the prospector to use methods on which he can rely, rather than allow himself to waste his time and money and break his heart on fraudulent schemes. Let me quote from the *Engineering and Mining Journal-Press*:

" 'The core drill and the diamond bit are well-tried tools; the shaft and the prospect hole will not deceive; after all, the best instrument of divination is the pick; there is intelligent curiosity in the point of it, there is strength in the handle of it; there is rhythm in the swing of it. Do not be too readily persuaded to discard it for new-fangled tools of exploration.' "

New York Section, A.I.M.E., Hears About China

China formed the interesting subject of an address given by Prof. Ellsworth Huntington, of Yale, at a meeting of the New York section of the A.I.M.E., held at the Fraternities Club on Wednesday evening, Nov. 12. Professor Huntington first spoke of the achievements of the Chinese, mentioning particularly the excellent work that they have done in architecture. Industry, economy, and patience were mentioned as their outstanding characteristics.

In many ways the Chinese are markedly different from Americans and Europeans, as, for example, in their indifference to public welfare and to the suffering of others. The stupidity of many of the people is also more noticeable in China than here, according to Professor Huntington. Natural conditions are largely responsible for many of the Chinese peculiarities, overpopulation, frequent famines, and long-continued floods having an important effect on the people.

Dr. Charles P. Berkey gave an interesting ten-minute discussion, and Prof. Arthur L. Walker and others also contributed.

To Study Ohio Raw Materials

As a part of a comprehensive plan to improve the industries of Cincinnati, the Commercial Club of Cincinnati is financing a scientific study of the raw materials in Ohio and other states which may be commercially tributary. The work is being done in the University of Cincinnati, largely by the staff of the Department of Geology and Geography. After collecting available data, supplementary field work will be undertaken. Provision is also made for technological work. These studies will continue for several years and will cost at least $50,000.

The staff engaged in the survey work now consists of Nevin M. Fenneman, Walter H. Bucher, Otto C. Von Schlichten, Earl C. Case, C. H. Behre, Jr., W. D. Johnston, Jr., and Charles V. Theis.

Recent Technical Publications

Reviews, Abstracts, and References

The Practical Science of Marketing

Scientific Distribution. Vol. CXV, No. 204 of the Annals of the American Academy of Political and Social Science. Published by the Academy, in Philadelphia. Price $2.

This volume falls in the domain of practical political economy. It is a collection of papers on modern business methods, with special reference to the problems of selling and distribution. In it the reader will find discussions so diverse as the marketing of eggs and the place of beauty in the business world. The functions of sales managers, of advertising, the rôle of the government in business, forecasting trade developments, statistics and other important topics are treated in short papers by specialists. No article in the collection fails to bring out some worthwhile phase of marketing science.

Despite the fact that some of the subjects are primarily of most value for the information given covering their respective fields, the underlying principles and practices described enable one to obtain a useful view of how other businesses are being conducted and their problems solved. There is a distinct absence of any theoretical atmosphere about the book, doubtless because the authors are business men who have not had much time for any but the more practical aspects of their work.

Many of the articles in the book disclose the results of original and painstaking investigation of a marketing or selling topic. For example, a valuable paper by Malcolm Muir, entitled "Breaking Down Sales Resistance in Industrial Selling," gives a clear analysis of the function of the industrial press in reaching specialized markets and describes the buying habits of industry.

Two absorbing papers appear early in the text—"Political and Governmental Tendencies in Their Relation to Increased Wealth," by Clyde L. King, and "Sales Policies and the Federal Trade Commission," by J. C. Young. Numerous other sections might be cited. The reader will find a diet varied enough to be read with profit and pleasure. In fact, the intellectual stimulus which a study of some of the papers provokes is the best recommendation that can be given the entire compilation.

This number of the Annals is a fitting companion for the many others that have been issued and is well up to the usual high standard of the Academy. F. E. WORMSER.

The Handbook of Industrial Oil Engineering. By John Rome Battle. Second edition. J. B. Lippincott Co., Philadelphia. Price $10.

The first edition of Mr. Battles' book was reviewed in these columns at some length on May 14, 1921. The early appearance of a revised second edition testifies to the worth of the book. Its appeal is particularly to the student of lubrication, a subject which it covers thoroughly, though it contains a large amount of matter of interest to any one who is connected with the production or use of petroleum or other oils.

Mineral Resources—Recently issued separates of the "Minerals Resources" series, published by the U. S. Geological Survey, Washington, D. C., and obtainable on request, include: "Mineral Resources of the United States in 1923 (Preliminary Summary)," by Frank J. Katz and Martha B. Clark, pp. 130; "Platinum and Allied Metals in 1923," by James M. Hill, pp. 13; "Quicksilver in 1923," by Clyde P. Ross and Isabel P. Evans, pp. 11; "Zinc in 1923," by C. E. Siebenthal and A. Stoll, pp. 20; "Bismuth, Selenium, and Tellurium in 1923," by Victor C. Heikes, pp. 7; "Chromite in 1923," by Edward Sampson and H. M. Meyer, pp. 5; "Fuel Briquets in 1923," by W. F. McKenney, pp. 8; "Slate in 1923," by G. F. Loughlin and A. T. Coons, pp. 12; "Peat in 1923," by K. W. Cottrell, pp. 2; "Clay in 1923," by Jefferson Middleton, pp. 8; "Barytes and Barium Products in 1923," by C. E. Siebenthal and E. R. Phillips, pp. 10; "Carbon Black Produced from Natural Gas in 1923," by G. B. Hutchinson, pp. 2; "Graphite in 1923," by Jefferson Middleton, pp. 7; "Fuller's Earth in 1923," by Jefferson Middleton, pp. 9; "Mica in 1923," by B. H. Stoddard, pp. 6; and "Coal in 1923," by F. G. Tryon and Sydney A. Hale, pp. 231.

North Carolina Gold—Don Maguire, a pioneer now residing in Ogden, tells the story of the discovery of gold in North Carolina in 1828, and the boom which followed, in a five-page article in the *Salt Lake Mining Review* for Aug. 30. Salt Lake City, Utah. Price 15c.

Patents

Dust Collector—No. 1,509,910-1-2-3. A. H. Stebbins, Los Angeles. Four types of apparatus for removing dust from air or other gases.

Ball Mill—Reissue No. 15,930. Oct. 7, 1924. D. V. Sherban, Canton, Ohio, assignor to the Bonnot Co., Canton, Ohio. A ball mill provided with a cylindrical screen extending longitudinally through the center of the mill.

Amalgamator — No. 1,510,733. Oct. 7, 1924. J. C. Wood, Lumberton, N. M. Design for an amalgamating plate.

No. 1,511,389. Oct. 14, 1924. H. N. Banks, Everett, Wash. A centrifugal amalgamator with rotatable bowl cast in aluminum.

Drill Bit—No. 1,511,466. Oct. 14, 1924. A. L. Hawkesworth, Butte, Mont., assignor to Hawkesworth Drill Co., Butte. A form of detachable drill bit, of a type described in detail in our issue of Aug. 5, 1922.

Hydrometallurgy of Copper — No. 1,514,153. Nov. 4, 1924. W. E. Greenawalt, Denver. Oxidized copper ores are leached with acid solution and the copper electrolytically precipitated. Iron salts are precipitated with copper oxide. A flow sheet is presented.

Volatilization — Reissue No. 15,931. Oct. 14, 1924. G. H. Wigton, Eureka, and S. M. Seddon, Salt Lake City, Utah. In the volatilization of metals from their ores, the patent covers the proper regulation of the composition of the material to be treated so that the non-volatile portions will not become fused or liquified at the temperature at which the process is carried on.

Tube Mill—No. 1,513,952. Nov. 4, 1924. A. H. Apted, Grand Rapids, Mich. Design for a tube mill, with feeding arrangements at each end and discharge openings at the center.

Amalgamator and Concentrator—No. 1,512,204. Oct. 21, 1924. C. E. Dickens, Pleasant Garden, N. C. A reciprocating table with curved riffles.

Crusher — No. 1,512,236. Oct. 21, 1924. Paul Phelps, Columbus, Ohio, assignor to Vogt Bros. Manufacturing Co., Louisville, Ky. A form of jaw crusher.

Oxide Reduction—No. 1,512,271. Oct. 21, 1924. Louis Burgess, Westfield, N. J., assignor in part to Maurice Barnett. Oxides are reduced by subjecting them, in divided form in contact with carbon, to the direct heat of an electric arc, in an inclosed space with gas pressure sufficient to prevent much volatilization.

Concentrators — No. 1,512,305. Oct. 21, 1924. O. B. Peck, Jr., Los Angeles. A centrifugal separating device consisting of a rotatable vessel with a differentially rotatable core forming the inner wall of the separating passage, adapted to concentrate materials of varying specific gravity from a water pulp.

No. 1,512,469. Oct. 21, 1924. L. M. Kellogg, Los Angeles. Design for a centrifugal concentrator.

No. 1,512,635. Oct. 21, 1924. R. J. Piersol, Houston, and A. D. Riley, Crafton, Pa., assignors to Standard Chemical Co., Pittsburgh. A rotary vessel for separating the values from the gangue in an ore pulp.

No. 1,512,687. Oct. 21, 1924. H. D. Hellmers, Las Vegas, Nev., assignor to West End Chemical Co., Oakland, Calif. A centrifugal separator for separating the light and heavy particles in dry material.

No. 1,513,693. Oct. 28, 1924. W. A. Butchart, Denver. A concentrating table with a channel extending diagonally across the riffled surface.

Sulphur Extraction — No. 1,512,320. Oct. 21, 1924. W. P. Thornton, Chicago. Ore containing sulphur is subjected to heat to melt the sulphur, then allowed to cool, washed to remove the mud, and the sulphur recovered.

Magnetic Separator — No. 1,512,344. Oct. 21, 1924. Paul Lorang, Metz, France. A magnetic separator consisting of an iron plate with electromagnetic coils, a helical conveyor for transporting the material along the plate, and shovels arranged between the windings of the helical conveyor.

Miners' Lamp—No. 1,513,068. Oct. 28, 1924. A. C. Recker, Oakville, Conn., assignor to Chase Companies, Inc., Waterbury, Conn. Design for burner and reflector of an acetylene miner's lamp.

New Machinery and Inventions

Measuring Steam by Means of Meters

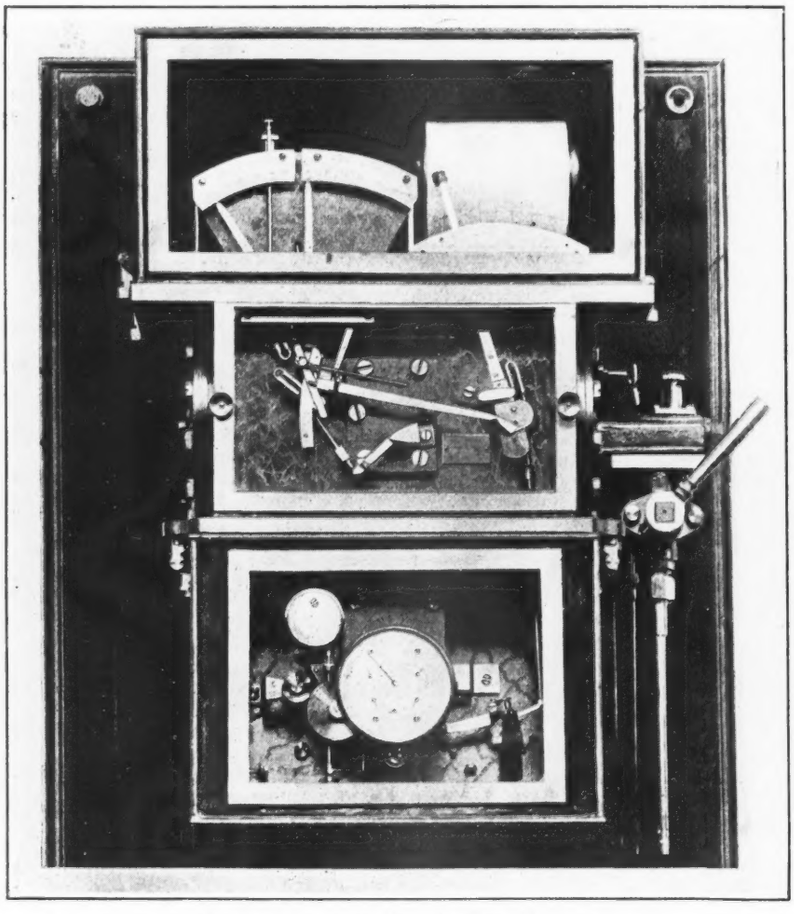
In industries where large quantities of steam are used, it is desirable to have some indication or record of the amount being generated by a certain boiler or battery of boilers or which passes along any particular steam main to engines or other steam-using appliances. To secure this record interesting instruments have been devised by an English manufacturer.

These meters act on the principles of the law governing the volume of a gas which will pass through an opening in a plate when impelled by a known difference in the pressures on the opposite sides of the plate. The gas flow varies as the square of the difference in pressure, and the simplest form of meter gives a direct indication of this rate of flow. This indication is a measure of the weight of the steam passing if the pressure remains constant, but allowances must be made for variations in the steam pressure, and a meter is used which automatically makes this correction. An elaboration of this instrument includes an integrator used for showing the total amount of steam passing in a given time period.

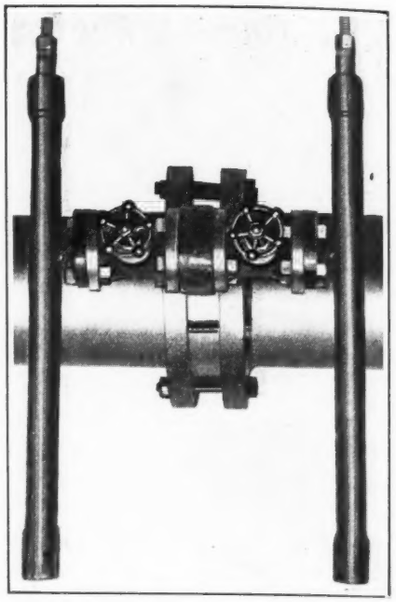
Two pressure passages in the orifice or opening carrier communicate with a pair of condensing columns which are bracketed off the main pipe. These columns are used in keeping the pipes leading to the metering instrument full of water at all times, so that the readings will not be affected by movements of the water service in transmitting the pressure to the measuring apparatus.

The rate of flow indicator depends for its action on the movement of a rubber diaphragm under the influence of variations in the difference of pressure on its opposite faces. The spaces on opposite sides of the diaphragm are in communication, by means of passages with the two sides of the opening plate in the steam pipe. A set of three coiled springs controls the movement of the diaphragm, which is communicated to a spindle through rods and a bell crank. A powerful permanent magnet is carried by this spindle. Outside the instrument case and in line with this spindle is another spindle to which is attached an iron armature and the pointer. In this way the movement of the diaphragm is transmitted to the pointer without it being necessary to make a water-tight rotating joint, and an exact register of the most minute movements is secured.

These instruments are manufactured by George Kent, Ltd., 199, High Holborn, London, W. C. 1, England.



A meter for recording the flow of steam
The mechanism automatically corrects for variations in pressure



Orifice fitting for producing differential pressure required to work the meter

A New Portable 40-Gallon Foamite Fire Extinguisher

A new 40-gal. portable foam chemical fire engine has recently been put on the market by the Foamite-Childs Corporation of Utica, N. Y. The new engine has substantially the same outward appearance as the old, but the internal construction has been entirely redesigned so that the quantity of Fire-foam generated is almost double that delivered by the old type from the same quantities of chemical solutions. The quality of foam produced throughout the entire discharge period is also much superior. In the old type of foam chemical engine, there are two containers, the outer shell or tank, and the inner tube. The solutions are held in these two containers and prevented from premature mixing by a stopple which seals the inner tube. When the engine is operated, the entire volume of the two chemical solutions is almost instantaneously mixed by being simply thrown together. The result is an immediate high pressure, which rapidly decreases during the period of effective discharge. The entire quantity of foam is generated almost at once, and the period of effective discharge is materially shortened owing to the foam breaking down in the machine and hose.

In the new metered type engine, a medium pressure is generated at the start, which gradually decreases during the entire period of effective discharge. This medium pressure is sufficient to provide an effective range during the entire discharge period.

Another important feature of the metered type engine is the increased period of effective discharge. This is made possible by the fact that the foam does not break down in the machine, and that the foam is discharged in a steady stream, rather than a great gush at the beginning of discharge.

The Underwriters' Laboratories have approved the device as effective on both Class A and Class B fires.

The Market Report

Daily Prices of Metals

Nov.	Copper, N. Y. net refinery	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
13	13.625@13.75	53.75	54.25	8.65	8.40@8.85	6.825@6.85
14	13.75	54.25	54.75	8.65	8.40@8.85	6.875@6.90
15	13.75	54.50	55.00	8.65	8.40@8.85	6.90
17	13.75	54.25	54.75	8.65	8.40@8.85	6.90
18	13.625@13.75	54.125	54.625	8.65	8.40@8.85	6.90
19	13.625@13.75	54.25	54.75	8.65	8.40@8.85	6.90
Av.	13.719	54.188	54.688	8.65	8.625	6.888

*These prices correspond to the following quotations for copper delivered: Nov. 13th, 13.875@14c.; 14th, 15th and 17th, 14c.; 18th and 19th, 13.875@14c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Nov.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
13	63⅞	65	68¼	256¼	259½	39⅜	37 1/16	35⅜	34 15/16
14	64	65	68¼	257¾	260⅝	39⅜	37¼	35½	35
17	64¼	65¼	68½	260½	263⅛	39⅝	37⅜	35⅝	35¼
18	64⅛	65⅛	68½	257¾	260¾	39⅞	37¾	35 9/16	35¼
19	64	65	68¼	259⅜	262¼	39¾	37⅝	35 7/16	35¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Nov.	Sterling Exchange "Checks"	Silver		Gold London	Nov.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
13	4.61⅞	69¾	34	90s 0d	17	4.61	69	33 9/16	89s 7d
14	4.63	69¼	33 7/16	89s 6d	18	4.61⅜	69¼	33 11/16	90s 0d
15	4.62½	69⅜	33 11/16	... ...	19	4.62¾	69⅜	33½	89s 7d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Zinc Strong but Copper and Lead Quieter

New York, Nov. 19, 1924—Sales on the non-ferrous metal markets have only been fair during the week. The demand for zinc has proved so strong that the market has moved to higher levels but that for copper and lead has decreased. Buying that has occurred seems predicated upon an active interest in the market by consumers. Speculation, if present, is a minor factor for the time being. Another reduction was made in the price of bismuth by the principal producer abroad in order to move large accumulations.

Copper Market Settling Down

Copper reached a 14c. delivered basis during the week. Some copper mining companies were able to obtain this price for their production almost every day; others shaded this level to attract business. Today some spot metal can be obtained for 13⅞c. delivered while the 14c. price can be beaten for January shipment. The advance that has taken place in copper is the consequence of a good consuming demand. Numerous producers are refraining from pressing any metal for sale, being well caught up with production and fearing to do anything which might affect the record the metal has recently made. The market has been quiet since Monday, more so here than in Europe. Consumption of American copper abroad continues good and the sales of some domestic producers to foreign customers have been so satisfactory that they have not been inclined to book any domestic orders, particularly in view of the better price which could be obtained in Europe, equivalent in certain cases to 14c., f.a.s.

Lead Sales in Smaller Volume

The official contract price for lead of the American Smelting & Refining Co. continues at 8.65c. per lb., New York.

So far as the actual amount of lead sold goes, the week passed is significant for the unusually light business done. In New York, contract sales were the only ones of importance; in St. Louis only moderate tonnages changed hands, although the western market outstripped New York in activity. Prices received for lead in the West ranged from 8.40c. to 8.85c., St. Louis, for common grades, with the tonnage about equally divided at these two levels. Some anxiety is expressed by producers over the prospect of substitutes being found and used for lead at present prices and one or two instances of substitution have already occurred, but lead has properties which make it difficult to find suitable substitutes. A poor quality of antimonial lead was sold during the week for $2 per ton below the price of common lead. The impurities in this antimonial lead were such that this discount had to be taken. Antimonial lead of better quality is worth the same price as common lead today. A few months ago it sold at discounts of 1½c. per lb.

Zinc Sales Continue Heavy

This is the second week of uncommonly large zinc sales. A total of over 5,000 tons of slab zinc was sold by producers in the domestic market at advancing prices. The market is now firmly upon a 6.90c. level in East St. Louis with the tendency upward. Galvanizers have been the most interested purchasers and have taken shipments of spot metal and also lots far into next year. There is practically no difference between the prompt and forward quotations made by producers. Export business has also held up splendidly. November promises to be a banner month in zinc sales in both the foreign and domestic market.

High-grade zinc continues to be sold for 8@8¼c. per lb. in good volume.

Tin Prices Fairly Steady

Consumers have been moderately interested in the tin market. They purchased about 500 to 600 tons per day

at the end of last week, which action helped to stiffen prices and gave a little upturn to the market. Forward tin commands the same price as spot metal.

Arrivals of tin, Nov. 10 to 17 inc., 4,180 long tons.

Silver Market Looks Better

Owing to lack of inquiry from the Far East, silver prices in London have continued to decline during the last week, although the New York market has shown little change. With the premium in London on the future quotation, and the local demand concentrating on forward deliveries, the market has broadened and shows a better undertone.

Mexican Dollars—Nov. 13th, 53⅞c.; 14th, 53½c.; 15th, 53⅝c.; 17th, 53¼c.; 18th, 53½c.; 19th, 53⅝c.

Sterling Touches New High

Sterling exchange reached a new high last Friday, which was almost duplicated today. On Tuesday, Nov. 18, closing cable quotations were: francs, 5.24c.; lire, 4.325c.; and marks, 23.82c. Canadian dollars, par.

Circulation Statement

The circulation statement of United States money for Nov. 1, as issued by the Treasury Department, shows the following stock of money:

Gold coin and bullion	$4,553,646,822
Gold certificates	(1,362,394,039)
Standard silver dollars	509,152,851
Silver certificates	(423,007,675)
Treasury notes of 1890	(1,410,326)
Subsidiary silver	278,321,002
United States notes	346,681,016
Federal Reserve notes	2,259,191,180
Federal Reserve bank notes	9,134,170
National Bank notes	774,281,624
Total Nov. 1, 1924	$8,730,408,665

Figures in parentheses are not included in the total.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, £125 per long ton.

Antimony—Per lb.:
Chinese brands, 15c.
Cookson's "C" grade, 16¾@17c.
Chinese needle, lump, nominal, 10c.
Standard powdered needle, 200 mesh, 11½c.
White oxide, Chinese, 99 per cent Sb_2O_3, 13@14c.

Bismuth—$1.50@$1.55 per lb. London, 6s. Reduction made Nov. 12.

Cadmium—60c. per lb. London, 2s. 2d.@2s. 6d.

Iridium—$260@$270 per oz.
Iridium alloyed with platinum, $280@$286.

Nickel—29@30c. per lb. for 99 per cent virgin metal. Electrolytic, 33c.; London, £160 per long ton.

Palladium—$83 per oz. Crude, $60@$65.

Platinum:
Refined, $118 per oz.
Crude, $111@$112.

Quicksilver—$68@$69 per 75-lb. flask. San Francisco wires $70; London £10§.

The prices of **Cobalt, Germanium Oxide, Magnesium, Molybdenum, Monel Metal, Osmiridium, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the prices given in the Nov. 8 issue.

Metallic Ores

Chrome — $18.50@$24, depending upon grade and source. Nominal.

Manganese—39@41c. per long ton unit, seaport, c.i.f., for Caucasian and Brazilian ore, plus duty. Consumers well provided.

Molybdenum — 70@75c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Tungsten Ore—Per unit, N. Y.:
Chinese wolframite, $8.50@$8.75.
High-grade western scheelite, $9.

Iron Ore, Galena and Pyrite Radio Crystals, Tantalum, and **Vanadium Ores** are unchanged from Nov. 8 quotations.

Zinc Ore Higher—Lead Firm

Joplin, Mo., Nov. 15, 1924

Zinc Blende

	Per Ton
High	$46.95
Premium, basis 60 per cent zinc	$47.00@$48.00
Prime Western, 60 per cent zinc	$46.00@$47.00
Fines and slimes	$44.00@$42.00
Average settling price, all	$45.30

Lead Ore

High	$123.60
Basis 80 per cent lead	$120.00
Average settling price, all	$117.12

Shipments for the week: Blende, 16,860; lead, 3,151 tons. Value, all ores the week, $1,132,690.

The shipment of 16,860 tons this week and a purchase of 15,150 tons for next week's shipment, against 14,420 tons produced, lowered reserve stocks materially.

At the close of the market tonight some sellers were declining to accept less than $47 basis Prime Western, and asking $47.50 basis. A few late sales were made on the $47 basis.

Buyers agree that the basic price for lead is only $120, but some sellers report settlements that indicate a higher basis having been paid.

Platteville, Wis., Nov. 15, 1924

Zinc	Per Ton
Blende, basis 60 per cent zinc	$48
Lead	
Lead, basis 80 per cent lead	$120

Shipments for the week: Blende, 620 tons; lead, 40 tons. Shipments for the year: Blende, 26,165; lead, 1,135 tons. Shipments for the week to separating plants, 1,049 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Beryl, Borax, Celestite, Chalk, China Clay, Corundum, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Ozocerite, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli and **Zircon** are unchanged from Nov. 8 prices.

Mineral Products

Arsenious Oxide (white arsenic)—6½@6¾c. per lb.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and **Zinc Oxide** are unchanged from Nov. 8 prices.

Ferro-Alloys

Ferromanganese—Domestic, German, and English, $105 per gross ton, f.o.b. works, or duty paid at seaport.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and Ferrovanadium are unchanged from the prices given in the Nov. 8 issue.

Metal Products

Rolled Copper—Sheets, 21⅜c. base; wire, 16¼c.

Lead Sheets—Full, 12c.; cut, 12¼c.

Nickel Silver—Grade A sheets, 18 per cent nickel, 27¾c. per lb.

Yellow (Muntz) Metal—Sheets, 19¼c. per lb.; rods, 16¼c.

Zinc Sheets—10.75c. per lb.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and **Zirkite** are unchanged from Nov. 8 prices.

Iron Trade Improves

Pittsburgh, Nov. 18, 1924

Though there has been no rush of buying in steel products since the election, a general increase in the volume of sales is to be noted, balancing the period of lighter buying just before the election, and a disposition on the part of many buyers to purchase farther ahead. In plates the open price of 1.80c. was cut sharply before the election, but an advance to 2c., the present level of bars, is considered possible. Mill operations continue at between 65 and 70 per cent of capacity, or at a shade above the average since the war.

Pig Iron—The recent decline of 50c. on bessemer, basic, and foundry has been recovered, with bessemer gaining an extra 50c., the market now being $20.50@$21 on bessemer, $19@$19.50 on basic and $19.50@$20.50 on foundry, f.o.b. Valley furnaces. Fully 600,000 tons of iron has been sold in all districts on this movement, which began in two or three sections before the election.

Connellsville Coke—First quarter furnace coke contracts are under consideration and it is understood one or two have already been closed. Operators are holding to $3.25 as minimum, some asking more, with inclusion of a clause whereby the buyer will protect the seller against all or a large part of any wage increase that may have to be made, most independent operators being now at about one-third under the Frick scale. The spot market remains dull at $3@$3.10 for furnace, $4@$4.50 for foundry, and $2.75@$2.90 for heating and smelter coke.

Company Reports

Utah Copper Co.

A report of the Utah Copper Co. for the third quarter of 1924 states that the total net production of copper from all sources was 53,253,845 lb., compared with the ouput of the two previous quarters, as shown in the statement of monthly production below:

Third Quarter, 1924	Pounds	Second Quarter, 1924	Pounds	First Quarter, 1924	Pounds
July	17,489,781	April	17,533,850	January	18,627,523
August	17,931,493	May	17,564,550	February	19,365,523
September	17,832,571	June	17,460,780	March	17,456,230
Totals	53,253,845		52,559,180		55,449,276
Average monthly production	17,751,282		17,519,727		18,483,092

During the quarter the Arthur plant treated 1,370,400 dry tons of ore and the Magna plant 1,620,700 dry tons, a total for both plants of 2,991,100 dry tons. The average grade of ore treated at the mills was 1.06 per cent copper and the average mill recovery of copper in the form of concentrates was 87.24 per cent of that contained in the ore, compared with 1.09 per cent copper and 88.02 per cent recovery, respectively, for the previous quarter.

The average cost per pound of net copper produced, including depreciation of plant and equipment and all fixed and general expenses and after crediting gold, silver, and miscellaneous earnings, was 9.4c., compared with 8.6c. for the preceding quarter, computed on the same basis. The value of gold and silver recovered and the miscellaneous earnings amounted to 1.04c. per pound of copper, as compared with 1.08c. for the previous quarter.

The following tabulation shows the financial results of the company's operations for the quarter compared with the two preceding quarters:

	Third Quarter 1924	Second Quarter 1924	First Quarter 1924
Net profit from copper production	$1,740,861.65	$1,956,007.81	$1,719,714.44
Miscellaneous income, including gold and silver	555,316.52	568,518.34	596,989.73
Bingham & Garfield Ry. dividend	100,000.00	100,000.00	100,000.00
Total income	$2,396,178.17	$2,624,526.15	$2,416,704.17
Depreciation	288,005.34	288,946.96	284,459.89
To surplus	$2,108,172.83	$2,335,579.19	$2,132,244.28

Earnings for the third quarter are computed on the basis of 13.133c. per lb. carrying price for copper, compared with 12.853c. for the second quarter and 12.782c. for the first quarter. A quarterly distribution to stockholders of $1 per share was made on Sept. 30, 1924, and amounted to $1,624,490.

Ray Consolidated Copper Co.

A report of the Ray Consolidated Copper Co. covering the operations of the company's properties for the third quarter of 1924 states that production was as follows:

Third Quarter, 1924	Pounds	Second Quarter, 1924	Pounds	First Quarter, 1924	Pounds
July	11,065,927	April	10,301,360	January	10,331,671
August	11,598,611	May	11,207,712	February	10,766,954
September	10,247,245	June	10,490,941	March	11,293,401
Totals	32,911,783		32,000,013		32,392,026
Average monthly production	10,970,594		10,666,671		10,797,342

The total ore milled at both properties was 1,394,300 dry tons, containing 1.54 per cent copper, compared with 1,352,000 tons of an average grade of 1.56 per cent copper in the second quarter and 1,433,600 tons, averaging 1.54 per cent copper, in the first quarter. The average daily tonnage handled by the mills during the quarter was 15,155 tons, against 14,857 tons in the second quarter and 15,754 tons in the first quarter.

The average mill extraction for the period was 78.60 per cent, corresponding to a recovery of 24.25 lb. copper per ton of ore treated, compared with 77.65 per cent and 24.19 lb. for the second quarter and 74.20 per cent and 22.91 lb. for the first quarter.

The cost per net pound of copper produced from all sources was 11.32c., compared to 11.28c. for the preceding quarter and 11.75c. for the first quarter. These costs include all operating and general charges of every kind, except depreciation and reserve for federal taxes. They also include the usual charges for retirement of prepaid mine development expense and take into account credits for miscellaneous income and the value of gold and silver recovered.

The financial results of operations for the quarter, compared with those of the two preceding quarterly periods, are as follows:

	Third Quarter 1924	Second Quarter 1924	First Quarter 1924
Operating profit from copper produced	$443,499.83	$429,041.30	$248,833.99
Miscellaneous income, including value of precious metals	61,238.20	123,938.57	94,785.44
Totals	$504,738.03	$552,979.87	$343,619.43

The above earnings are based on an average carrying price for copper of 12.85c. for the third quarter, compared with 13.01c. and 12.81c. for the second and first quarters, respectively.

Improvements in equipment and operating methods which have been in progress at both the Ray and Chino properties, and mine development at both, continued at a normal rate throughout the quarter.

Nevada Consolidated Copper Co.

A report of the Nevada Consolidated Copper Co. of operations for the third quarter of 1924 gives production record as follows:

Third Quarter, 1924	Pounds	Second Quarter, 1924	Pounds	First Quarter, 1924	Pounds
July	5,702,048	April	5,707,574	January	6,196,556
August	5,708,222	May	5,735,811	February	6,435,134
September	5,756,222	June	5,739,704	March	5,703,167
Totals	17,166,492		17,183,089		18,334,857
Average monthly production	5,722,164		5,727,696		6,111,619

A total of 831,700 tons dry weight of Nevada Consolidated ore was milled and 8,159 dry tons of Ruth mine direct-smelting ore, averaging 7.04 per cent copper, was shipped to the smelter. Besides the company ores received, 7,389 dry tons of direct-smelting custom ores was received and treated at the smelter.

The average grade of ore treated at the concentrator was 1.18 per cent copper, and the average mill recovery of copper in concentrates was 87.69 per cent, compared with 1.23 per cent heads and an 85 per cent recovery for the previous quarter.

The cost of production, including charges for depreciation and all fixed and general expenses and after credit for gold and silver values and miscellaneous earnings, was 11.42c. per lb. of copper produced, as compared with 11.36c. per lb. for the preceding quarterly period.

The financial outcome of operation is shown in the statement submitted below, in comparison with the outcome of previous quarterly periods:

	Third Quarter 1924	Second Quarter 1924	First Quarter 1924
Operating gain from production of copper	$250,292.95	$229,257.33	$199,610.82
Value gold and silver and miscellaneous earnings	166,991.71	177,093.71	213,849.34
Nevada Northern Ry. Co. dividend	100,000.00	100,000.00	150,000.00
Total income	$517,284.66	$506,351.04	$563,460.16
Plant and equipment depreciation	150,429.72	150,429.72	150,429.72
Increase in earned surplus	$366,854.94	$355,921.32	$413,030.44

Earnings for the third quarter are taken into accounts on the basis of 12.98c. per lb. carrying price for copper, compared with 12.85c. for the second quarter and 12.75c. for the first quarter of the year.

All major construction planned for the present or immediate future at the concentrator and power plant has been completed, and installation for increased capacity at the crushing plant, the roasters and the converter department will soon be finished, thus ending the period of heavy expenditures for improvement purposes.

Mining Stocks

Week Ended November 15, 1924

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Alaska-Br. Col.	N. Y. Curb	*11	*10	*10	
Anaconda	New York	39⅞	37½	39½	De.15, Ja.21, Q 0.75
Arcadian Consol.	Boston	1⅛	1	1	
Ariz. Com'l.	Boston	11⅝	10½	11½	Jy.19, Jy.31 0.50
Calaveras	N. Y. Curb	3	1⅞	3	
Calumet & Arizona	Boston	54½	51	53½	Se. 5, Se. 22 Q 0.50
Calumet & Hecla	Boston	17⅞	15½	17⅜	My. 31, Jn. 16 0.50
Canario Copper	N. Y. Curb	4¼	4	4¼	
Cerro de Pasco	New York	48⅞	46⅛	48⅛	Oc. 23, No. 1 1.00
Chile Copper	New York	34⅞	33⅛	34	De.3, De.29, Q 0.62½
Chino	New York	26⅛	23¼	25⅞	Sept., 1920 0.37½
Con. Coppermines	N. Y. Curb	3 1⅛	3	3⅛	
Copper Range	Boston	27⅜	24½	27	May, 1923 1.00
Crystal Copper	Boston Curb	*67	*62	*63	
Davis-Daly	Boston	*45	*40	*40	Mar., 1920 0.25
East Butte	Boston	4⅜	4⅛	4⅛	Dec., 1919 0.50
First National	Boston Curb	*39	*36	*36	Feb., 1919 0.15
Franklin	Boston	*75	*70	*70	
Gadsden Copper	Boston Curb	*63	*63	*63	
Granby Consol.	New York	19⅛	17⅜	17⅜	May, 1919 1.25
Greene-Cananea	New York	16⅛	15⅛	16	Nov., 1920 0.50
Hancock	Boston	1⅛	1	1	
Howe Sound	N. Y. Curb	2⅜	2⅛	2⅛	Ap.1,Ap.15, Q 0.05
Inspiration Consl.	New York	29⅝	25	28½	De.20, Ja.7, Q 0.50
Iron Cap	Boston Curb	2	1⅞	2	May, 1923 0.15
Isle Royale	Boston	17⅜	15½	15½	Se. 1, Se. 15 0.50
Jerome Verde Dev.	N. Y. Curb	1	*95	*95	
Jib Consol.	N. Y. Curb	*41	*35	*38	
Kennecott	New York	50	48	49⅜	Se.5, Oc.1, Q 0.75
Keweenaw	Boston	1⅛	1	1	
Lake Copper	Boston	†2	†1½		
Magma Copper	New York	37	35	35⅞	Jan., 1919 0.50
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛	
Mass Consolidated	Boston	1⅛	1	1	Nov., 1917 1.00
Miami Copper	New York	23⅛	21⅞	22⅜	No.1 No.15 Q 0.50
Mohawk	Boston	37⅛	33	33	Se. 22, Oc. 13 1.00
Mother Lode Coa.	New York	8⅛	7⅜	8⅛	Jn. 13, Jn. 30 0.37½
Nevada Consol.	New York	14¼	13¾	14⅛	Sept., 1920 0.25
New Cornelia	Boston	†22	†20		No. 7, No. 24 0.25
New Dominion	N. Y. Curb			2½	
North Butte	Boston	3⅛	2⅞	3	Oct., 1918 0.25
Ohio Copper	N. Y. Curb	1⅛	1⅛	1⅛	No.14, De.2 0.05
Old Dominion	Boston	†24	22½		Dec., 1918 1.00
Phelps Dodge	Open Mar.	†109	†105		Se.20, Oc.1 Q 1.00
Quincy	Boston	†24½	†22	21	Mar., 1920 1.00
Ray Consolidated	New York	16	13⅞	15⅞	Dec., 1920 0.25
Ray Hercules	N. Y. Curb	*19	*16	*19	
St. Mary's Min. Ld.	Boston	38	36	37½	Ap.22, My.20 3.00
Seneca Copper	New York	1⅛	1⅛	1⅛	
Shannon	Boston	*1⅛	*99		Nov., 1917 0.25
Shattuck Arizona	New York	7⅞	7⅛	7½	Jan., 1920 0.25
Superior & Boston	Boston	1⅜	1⅛	1⅛	
Tenn. C. & C.	New York	8½	7⅞	8	De.31, Ja.15,Q 0.25
United Verde Ex.	N. Y. Curb	29	27	28⅜	Oc. 3, No. 1 0.50
Utah Copper	New York	82	79	79⅝	Se.15, Se.30,Q 1.00
Utah Metal & T.	Boston	†*30	†*26		Dec., 1917 0.30
Victoria	Boston	*95	*60	*60	
Walker Mining	N. Y. Curb	3	2⅛	2⅛	
Winona	Boston	†*45	†*40		
NICKEL-COPPER					
Internat. Nickel	New York	20⅜	20	20⅛	Jy.17, Au.1, Q 1.50
Internat. Nickel pfd.	New York	95	94½	94½	Oc.16, No.1, Q 1.50
LEAD					
Carnegie Lead & Zinc	Pittsburgh	4⅛	3⅜	3⅜	
National Lead	New York	160¾	156¾	159¾	Se.12, Se.30, Q 2.00
National Lead pfd.	New York	117⅛	117	117	No.21,De.15, Q 1.75
St. Joseph Lead	New York	38	35½	38	De. 9, De. 20 0.50
ZINC					
Am. Z. L. & S.	New York	9⅜	8⅛	8⅜	May, 1920 1.00
Am. Z. L. & S. pfd.	New York	32½	29½	29½	Nov., 1920 1.50
Butte C. & Z.	New York	7¼	6½	7	De.10, De.23 0.50
Butte & Superior	New York	18⅛	16⅜	17⅜	De.10, De.23, 0.50
Callahan Zn-Ld.	New York	4⅜	3⅜	4	Dec., 1920 0.50
New Jersey Zn.	N. Y. Curb	178	165	177	Oc.,No.,'24 QX 4.00
United Zinc	N. Y. Curb			*25	
Yellow Pine	Los Angeles	*59	*59	*59	June, 1924 0.04
SILVER					
Alvarado	Boston Curb	2⅛	1⅞	1⅞	
Beaver Consol.	Toronto	*22	*17½	*21	May, 1920 0.03
Castle-Trethewey	Toronto	*75	*72	*74½	
Coniagas	Toronto	2.25	2.22	2.22	Ap.20, My.1 0.02½
Crown Reserve	Toronto	*54	*50½	*53	Jan., 1917 0.05
Keeley	Toronto	2.30	2.22	2 28	Sept. 15, SA 0.12
Kerr Lake	N. Y. Curb	1⅞	1⅞	1⅞	Oc. 1, Oc. 15, 0.12½
La Rose	Toronto	*8	*8	*8	Apr., 1922 0.10½
Lorrain Trout Lake	Toronto	1.46	1.43	1.44	
McKinley-Dar.-Sav.	Toronto	*12⅜	*12	*12½	Oct., 1920 0.03
Mining Corp. Can.	Toronto	2.70	2.60	2.65	Sept., 1919 0.12½
Nipissing	N. Y. Curb	6⅛	6	6⅛	Oc.1,Oc.20,QX 0.30
Ontario Silver	New York			7	Jan., 1919 0.50
Temiskaming	Toronto	*20	*19½	*19½	Jan., 1920 0.40
GOLD					
Alaska Gold	New York	*15	*12¼	*12½	
Alaska Juneau	New York	1⅛	1	1	
Argonaut	Toronto	*24	*23	*23½	

Stock	Exch.	High	Low	Last	Last Div.
Carson Hill	Boston	*75	*37	*40	
Cresson Consol. G.	N. Y. Curb	4	3⅜	3⅜	Se.30, Oc.6 Q 0.10
Dome Mines	New York	14¼	14⅛	14½	Oc.3, Oc.20, Q 0.50
Golden Cycle	Colo. Springs	1.31	1.31	1.31	My.31, Jn.10 Q 0.03
Hollinger Consol.	Toronto	14.45	13.85	14.40	No.13, De.1, 0.05
Homestake Mining	New York	45½	43⅜	43⅜	No.2, No.25,M 0.50
Kirkland Lake	Toronto	*24	*19	*23	
Lake Shore	Toronto	3.93	3.88	3.89	Se.1, Se.15, Q 0.05
McIntyre-Porcupine	New York	16	15½	15⅝	No. 1, De. 1 0.25
Newray	Toronto	*25	*22½	*23½	
Portland	Colo. Springs	*45	*45	*45	Oct., 1920 0.01
Teck-Hughes	Toronto	1.18	1.13	1.14	
Tom Reed	Los Angeles	*22½	*20	*20½	Dec., 1919 0.02
Tough-Oakes	Toronto	*44	*37½	*41	
United Eastern	N. Y. Curb			*40	Jy.18, Jy.31, Q 0.05
Vipond Cons.	Toronto	1.26	1.23	1.24	
Wright-Hargreaves	Toronto	4.00	3.65	3.70	Se.15,Oc.1, Q 0.02½
GOLD AND SILVER					
Black Oak	N. Y. Curb			*89	
Con. Cortez	N. Y. Curb	*12	*12	*12	
Con. Virginia	San Francisco	*4½	*4½	*4⅜	
Continental Mines	N. Y. Curb	1⅛	1⅛	1⅛	
Dolores Esperanza	N. Y. Curb			*32	Jy.1, Jy.10 Q 0.05
Premier Gold	N. Y. Curb	2¼	2⅛	2⅛	Se. 25, Oc. 30 0.08
Tonopah Belmont	N. Y. Curb	*57	*52	*52	Apr., 1923 0.05
Tonopah Divide	N. Y. Curb	*19	*17	*18	Se. 22, Oc. 10 0.10
Tonopah Extension	N. Y. Curb	3⅜	3⅛	3⅛	Se. 10, Oc. 1 0.05
Tonopah Mining	N. Y. Curb	1⅛	1⅛	1⅛	Se. 30, Oc. 21 0.07½
Unity Gold	N. Y. Curb	*95	*95	*95	
West End Consol.	N. Y. Curb	*60	*60	*60	Mar., 1923 0.05
Yukon Gold	N. Y. Curb			*50	June, 1918 0.02
SILVER-LEAD					
Ahumada	Boston Curb	7	6¼	6¼	Se.16, Oc.2, X 0.15
Bingham Mines	Boston	†18¼	†16		Sept., 1919 0.25
Cardiff M. & M.	Salt Lake	1	1	1	De.16, No.18 0.10
Chief Consol.	Boston Curb	3⅛	2⅞	3⅛	Ap.19, My.1,Q 0.10
Columbus Rexall	Salt Lake	*24	*23	*23	Aug., 1920 0.03
Consol. M. & S.	Montreal	48⅛	47	47	Jn.30, Jy.15 0.75
Daly Mining	Salt Lake			2.00	July, 1920 0.10
Erupcion	Boston Curb	2⅛	2⅛	2⅛	Se. 15, Oc. 2, X 0.15
Federal M. & S.	New York	17⅛	13⅛	16	Jan., 1909 1.50
Federal M. & S. pfd.	New York	56⅞	53	55⅛	No.25, De.15, 1.75
Florence Silver	Spokane	5⅜	4	4	Apr., 1919, QX 0.01
Hecla Mining	N. Y. Curb	9⅛	9⅛	9⅛	No.15, Dn.15 0.25
Iron Blossom Con.	N. Y. Curb			*25	Oc.25, 1924 0.02½
Marsh Mines	N. Y. Curb			*5	June, 1921 0.02½
Park City	Salt Lake	4.65	4.65	4.65	Se. 15, Oc. 1 0.15
Park Utah	N. Y. Curb			3⅛	Mc. 15, Ap. 1 0.15
Prince Consol.	Salt Lake	*8⅛	*8	*8⅛	
Silver King Con.	N. Y. Curb			*50	
Silversmith	Spokane	*30	*29½	*29½	Oc. 1, Oc. 10 0.01
Tamarack-Custer	Spokane	1.45	1.43	1.44	Se. 22, Se. 29 0.25
Tintic Standard	Salt Lake	8.25	8.00	8.25	Se.1, '24, X 0.25
Utah-Apex	Boston	3	2⅛	2⅛	Se.5, Se.15, Q 0.25
IRON					
Bethlehem Steel	New York	45	42⅛	44⅜	Jn.1, Jy.1, Q 1.25
Char. Iron	Detroit	*30	*30	*30	
Char. Iron pfd.	Detroit	*73	*70	*70	
Colorado Fuel & Iron	New York	42⅛	38	41⅛	Au.11, Au.25,Q 2.00
Col. Fuel & Iron pfd.	New York			108⅛	No.10, No.26 Q 2.00
Gt. North'n Iron Ore	New York	33⅛	31⅛	33⅛	De.10, De.27 2.00
Inland Steel	N. Y. Curb			4	No.14, De.1, Q 0.62½
Mesabi Iron	N. Y. Curb			2⅛	
Replogle Steel	New York	15⅞	13⅛	14⅛	
Republic I. & S.	New York	49⅞	45	48	May, 1921 1.50
Republic I. & S. pfd.	New York	88	85	87	Se.15, Oc.1, Q 1.75
Sloss-Sheffield S. & I.	New York	74½	70⅛	73	Se.11, Se.20, Q 1.50
Sloss-Shef. S.&I. pfd.	New York	91⅜	90⅞	91⅜	De.9, De.20, Q 1.75
U. S. Steel	New York	115⅛	112⅜	114⅜	No.29,De.3, QX 1.75
U. S. Steel pfd.	New York	122⅞	121⅞	122	No.4, No.29, Q 1.75
Virginia I. C. & C.	New York	36	36	36	De.15, Ja.2 1.50
Virginia I.C.&C.pfd.	New York	77	77	77	Jn. 17, Jy. 1 2.50
VANADIUM					
Vanadium Corp.	New York	28¼	25⅛	27⅛	Jan., 1921 1.00
ARSENIC					
Western Utah Copper	N. Y. Curb	*16	*15	*16	
ASBESTOS					
Asbestos Corp.	Montreal	30	26	30	Se.29, Oc.15 Q 1.00
Asbestos Corp. pfd.	Montreal	70	69	70	Oc.1, Oc.15, Q 1.50
SULPHUR					
Freeport Texas	New York	9	7⅛	8⅛	Nov., 1919 1.00
Texas Gulf	New York	85	81⅛	82⅛	Se.2,Se.15, QX 1.75
PLATINUM					
So. Am. Gold & P.	N. Y. Curb	4⅞	4⅛	4⅛	
MINING, SMELTING AND REFINING					
Amer. Metal	New York	49	47⅛	49	No.19, De.1 Q 0.75
Amer. Metal pfd.	New York	113	113	113	No.20, De.1, Q 1.75
Amer. Sm. & Ref.	New York	86⅛	82⅛	84⅜	Oc.17, No.1, Q 1.25
Amer.Sm.&Ref.pfd.	New York	106¼	105¼	105¾	No.17, De.1 Q 1.75
U. S. Sm. R. & M.	New York	36	34	35	Jan., 1921 0.50
U.S. Sm. R.&M.pfd.	New York	46	45⅛	45⅞	Oc.9, Oc.15 Q 0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.